BULLETIN OF MISCELLANEOUS INFORMATION No. 3 1931
ROYAL BOTANIC GARDENS, KEW

XVIII.—INTRODUCTION OF CINCHONA TO INDIA.

The tercentenary (1630-1930) of the introduction of Peruvian or *Cinchona* bark into Europe, which was recently celebrated in London and Missouri, makes it of interest to recall the work of the Royal Botanic Gardens, Kew, in the introduction of *Cinchona* plants to cultivation in British India and various British Colonies.

The chief circumstances leading to the demand for cultivating *Cinchona* were the destruction of the native South American forests owing to the methods of collection, and the consequent growing scarcity of the bark. The explorer Ulloa (1735) reported to the Spanish Government that " the habit of cutting down the trees in the forests of Loxa and afterwards barking them without taking the precaution of replanting would undoubtedly cause their complete extirpation " (Markham, Cinchona, p. 19). Humboldt, at the time he travelled on the Andes (1799), found that " to procure the small supply of 11,000 Spanish pounds no less than 800 or 900 *Cinchona* trees were cut down every year " and that " the older and thicker stems are becoming more and more scarce " (Views of Nature, p. 391). About the beginning of the 19th century, McCulloch (Dict. of Commerce, London, 1834, p. 120) records that " Peruvian " or " Jesuits " bark was known in commerce under three principal kinds, the first stated to be " the ' pale bark ' (Loxa bark) of the shops, the original Cinchona of Peru, now very scarce." The second and third barks of this date were " Red bark " from the Andes of Ecuador and " Yellow bark " of the shops, which was grown in Quito and Santa Fe.

The destructive methods of collection and the growing scarcity of " Loxa bark " are still further indicated by Cross in his report to the Under Secretary of State for India dated Sierra de Cajanuma, Loxa, November 9th, 1861, in which he says: " The plants from which the bark of commerce is now taken are in general not more than 8 to 10 feet in height, . . . some of the more industrious cascarilleros frequently pull up the roots and bark them also and bark is taken from the smallest twigs."

Other instances of reckless extravagance in the collection of the bark might be quoted ; but enough has been said to show that signs were not wanting of the rapid destruction of the forests for at least a century before any thought of cultivation or conservation occurred to those responsible for maintaining supplies of the precious bark. It became clear that under these conditions and with the wild plants

limited to a definite area the supply would soon be exhausted. It is to the Secretary of State for India, with the assistance of the Director of the Royal Botanic Gardens, Kew, that credit is due for the eventual appreciation of the situation, in the year 1858, when steps were taken to provide for the future. The Government of the Netherlands, in 1852, had begun the cultivation of the plant in Java.

Dr. Forbes Royle, in 1835, had already recommended the introduction of the *Cinchona* plant into India, pointing out the Nilgiris as a suitable place for experiment (Himalayan Botany, i. p. 240). He made a report to the Directors of the Honourable East India Company, dated East India House, March, 1857, in which he refers to having drawn up in 1852 detailed instructions to enable Her Majesty's Consuls, in the South American countries where the plants grew, to assist in the project, but the results were unsuccessful. He also records a small experiment with living *Cinchona* plants :— " Knowing that Dr. Weddell, who has explored the Southern Cinchona regions, discovered the ' Calisaya,' or that species which yields the best ' yellow bark ' and that he had brought home seeds of this valuable species which had germinated and produced young plants, both in France and in this country, I applied to and obtained from the Botanic Gardens of Kew and Edinburgh, as well as from the Horticultural Society [at Chiswick], six plants of the true *Cinchona Calisaya*."

Robert Fortune, who at that time was proceeding overland on his Mission to China to obtain tea seeds and plants, " was requested to take charge of these plants, which he himself packed into a small Ward's case. These were conveyed by him along with the passengers of the mail of January, 1854, across the desert, and five of the plants safely reached the Calcutta Botanic Gardens, then under the superintendence of Dr. Falconer." They did not thrive well at Calcutta and were sent to Darjeeling, where three of the original plants arrived alive, but the final report of Dr. A. Campbell, called for by the Medical Board of the East India Company (letter from the Medical Board to the President in Council dated Fort William, 9th June, 1855), was that " all the Cinchonas were killed by the cold of last winter." Finally in his memorandum Dr. Royle advised the employment of a special agent or the sending of a collector to the Cinchona regions. He died, however, before it was possible to act on his advice, and nothing seems to have been done until the matter was taken up by the Secretary of State for India in 1858 on the transfer of the authority in India from the East India Company. Dr. Royle's successor was to be directed to carry out the recommendations alluded to without further delay ; but in the meantime Mr. Clements Markham, a clerk in the Department of India Correspondence, offered his services for the purpose, understanding, as he said in his application, that " it is the intention of the Secretary of State to take measures for the introduction of the Cinchona Plant into India " and referring to the fact that he was already " well

acquainted with several of the forests in Peru and on the frontiers of Bolivia containing the Cinchona Tree."

Markham was entrusted with the commission and lost no time in making arrangements for his important explorations. His knowledge of the country and the requirements led him to organise a triple expedition to begin operations early in 1860. Dr. Spruce and Mr. Robert Cross were to work the regions of Loxa bark (*Cinchona officinalis* Linn.; syn. *C. condaminea*) and "Red Bark" (*C. succirubra* Pavon) in Ecuador; Mr. Pritchett was to explore the forests of Huanuco and Huamalies in Northern Peru; whilst he himself, with Mr. John Weir as assistant, undertook the exploration of the Calisaya region (*C. Calisaya* Wedd.) in Bolivia and Southern Peru, mainly centred in the forests of Caravaya.

It was at this stage that the assistance of Kew became valuable. The Reports of the Director, Sir Wm. Hooker, from 1860 onward contain an interesting record. In his Report for 1861 he states:—

"The means adopted for introducing Cinchonas (trees yielding quinine) into the East Indies and our Tropical Colonies, rank first in point of interest and importance of the works of the past year. In my report for 1860 I mentioned the erection, at the desire of the Secretary of State for India in Council, of a forcing house especially for the cultivation of the Cinchonas, with the view of establishing plantations of them in India; the operations of the several parties organised to proceed into the Andes and procure young plants and seeds have been described in detailed reports laid before the Secretary of State for India by Clements R. Markham, Esq.

"Upon the Royal Gardens devolved the duties of receiving and transmitting the seeds and plants to India, of raising a large crop of seedlings, of nursing the young stock, lest those sent on should perish or the seeds lose their vitality, and of recommending competent gardeners to take charge of the living plants from the native forests to the hill country of India, and to have the care of the new plantations there."

Further, with the sanction of the Indian and Colonial Governments, it was arranged that our West Indian Colonies and Ceylon should be supplied with a portion of the seeds. The results obtained were the following:—

"In the Nilgiri Hills, I am informed by Sir W. Denison (Governor of Madras) that there are at this time flourishing 3,477 plants of the Red bark (*Cinchona succirubra*), one of the best kinds, many of which are from 3 to 3 ft. 9 in. in height, and 2,370 of other kinds equally healthy. Many of these are ready to be planted out in sites already selected by Mr. Markham.

"In the Royal Gardens we have 2,170 healthy young plants which will be ready for transmission to India at the proper season.

"In Ceylon under the management of Mr. Thwaites, Director of the Royal Gardens at Peradeniya, the experiment has been equally successful in proportion to the quantity of seeds received. A plantation of different kinds is flourishing at Newra-Ellia.

" In Jamaica the *C. succirubra* is succeeding admirably. A quantity of healthy seedlings has been transported to a locality 4000 feet above the sea and are now ready for planting out. Mr. Wilson, the Superintendent of the Botanic Gardens there, has made a requisition to Government for 50 acres of land to form a plantation therewith and for an assistant to take charge of the plantations.

" Seeds were sent to Trinidad at the same time as to Ceylon and Jamaica, but unfortunately not one has germinated."

In 1862 (Kew Report, p. 2) the Director referred to the two last reports in which he described " the assistance afforded by us in introducing Cinchona plants into our Foreign Possessions, namely, to India, where Mr. Markham's exertions have achieved remarkable success, and to Ceylon and the West Indian Colonies by the Royal Gardens." He gave the following concise statement of the results—" on the Nilgiris, under charge of Mr. McIvor, 117,706 plants, in the Sikkim Himalaya under Dr. Anderson 2000 plants, and in Ceylon under Mr. Thwaites about 3000 plants."

In the Kew Report for 1867 (p. 5) it is stated that " Cinchona has hitherto failed in Trinidad and Dominica " and that " Jamaica had 30,000 plants under cultivation."

Annual reports of the progress are continued until 1874, when the Director (Sir Joseph Hooker) was in a position to state that " the introduction of this febrifuge into India, Ceylon and Jamaica being now accomplished this subject no longer demands a notice in my report."

The official association of the India Office and Kew in respect of the introduction was regarded as completed three years after the date of Markham's first appointment as organiser and leader of the expedition to South America. This was conveyed in the following communication from the Secretary of State for India to Sir William Hooker :—

" The Secretary of State for India in Council having received an application through Earl Russell from the French Government, for a supply of Cinchona plants for transmission to Algeria, I am to request that you will reserve 200 or 300 plants for transmission to that destination. You will be informed in a few days with whom you should communicate for the liquidation of any expenses which may arise under this head.

" I am also directed to inform you that it has been resolved by the Secretary of State in Council, in consequence of the success which has attended the cultivation of the Cinchona plant in the Government Gardens at Ootacamund, to discontinue the auxiliary establishment under your charge in the Royal Gardens at Kew, and that the time has arrived when your account with this office may be closed. It will therefore rest with you to determine respecting the disposal of the plants under your charge after having allotted those required for the French Government."

" I am to take this opportunity of expressing the thanks of the Secretary of State for India in Council for the ready and able assistance which has been afforded by yourself and your subordinates on every occasion when it was required to promote the success of this important experiment, which has now been initiated in several quarters of Her Majesty's Dominions."

The compliance with the request of the French Government may be regarded as singularly appropriate at the conclusion of this notable experiment, when it is remembered that the first plants of *Calisaya* sent out to India were raised from seed supplied by the French botanist and explorer of the Calisaya region, Dr. Weddell, of whom in 1857 it was stated (Dr. Royle in his memo. dated March, 1857, above mentioned) that the plants of this species, which were at one time very numerous in hot-houses in Europe, were all obtained from seeds brought home by him.

In St. Helena a substantial number of plants of " Red bark " (*C. succirubra*) and " Loxa bark " (*C. officinalis*) were established by a gardener sent out from Kew. These plants at first gave every promise of success but were evidently neglected. In 1874 (Kew Report 1874, p. 5) Sir Joseph Hooker reported that " the subject of Cinchona cultivation in the Colony has been again brought under the notice of the Government owing to the fact of a large proportion of trees introduced there ten years before from Kew having been found after years of neglect to be in a flourishing condition. The suitability of the island for Cinchona cultivation has now been indisputably proved and the question of continuing it must depend on other considerations."

It is interesting to note that Sir Joseph's opinion on this subject was recently quoted in a letter to the " Times " of December 22nd, 1930—" In about 1901 I was speaking at Sunningdale with Sir Joseph Hooker, my godfather, and, knowing a little of the commercial results of some of his activities, I asked him which of them he thought had been the most important in its results. He replied with emphasis, ' Quite certainly, the getting of cinchona into India, the result is that anyone can get at any post office a dose of pure quinine for a little less than a half-penny.' "

The collections at Kew contain samples of packets of quinine and " Cinchona febrifuge " together with an extensive series of the Quinine barks of commerce, and illustrations of the cultivation in the East and production in South America ; they are especially representative of British India and of experiments in various colonies, including Ceylon, Jamaica, St. Helena, Tanganyika and the Cameroons.

XIX.—RESEARCHES ON SILENE MARITIMA AND S. VULGARIS*: V.

E. M. Marsden-Jones and W. B. Turrill.

Individuals, Characters, and Populations of S. vulgaris occurring in Nature.

In the present paper (the fifth of the series) we deal only with *S. vulgaris* as we have studied it in wild material or in direct offspring of wild material. We first describe a number of stock-plants which have been used in extensive breeding work, the results of which are to be described in later parts. The plant organs of *S. vulgaris* are considered *seriatim* and the character variations we have found are dealt with in some detail. Wild populations are then analyzed, partly by extension of the scheme already published (*K.B.* 1929, pp.168 seq.).

It will be seen that this paper is complementary to that published as No. III in *K.B.* 1929, pp. 145-175.

Stock-Plants of S. vulgaris.

A description of stock-plant B.1 was given in our first paper of this series (*K.B.* 1928, I). Plant B.2 was collected on the site of a disused camp about 10 miles north of Salisbury, Wilts, 1926. Plants B.3 to B.10 were collected in Potterne Field, Wilts, 1926, and plants B.11 to B.16 from the same population in 1927. No barren shoots occur in any of the plants. The leaf shape and colour are as in B.1 (from broadly lanceolate, or ovate-lanceolate, to narrowly elliptic, and distinctly green) unless otherwise stated.

B.2. *Habit* erect, stems up to 5·8 dm. high, glabrous, with little anthocyanin ; plant female.

Leaves (average) 5·4 cm. long, 2·5 cm. broad, margins minutely crenulate, glabrous.

Inflorescence with up to 22 flowers, more or less drooping ; bracts as in B.1 (all at first green-herbaceous, later many becoming scarious, all very sparingly ciliate or lowest without cilia, lowest ovate, acuminate).

Calyx shape as in B.1 (inflated, ovoid, contracted at apex) ; with a trace of anthocyanin ; teeth equilaterally triangular, apex acute apiculate.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous ; petals 1·9 cm. long. 8 mm. broad† with barely a boss, corolla diam. 1·8 cm.

Immature seeds white. *Stigmata* pink.

Ripe capsules obloid, 6·5 mm. long‡, 8 mm. diam. ; teeth§ 1 mm. long, erect ; mouth 2 mm. diam.

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*Continued from *Kew. Bull.* 1929, p. 200.

†The petal measurements for the stock-plants were all made from living flowers when these were fully expanded in the evening. Our experience suggests that several years of cultivation tends to increase flower size.

‡Length of capsule is always given up to the base of the teeth only.

§ The teeth are equilaterally triangular, unless otherwise stated.

Carpophore 2 mm. long, 2 mm. diam.
Mature seeds strongly tubercled.

B.3. *Habit* erect, stems up to 7·5 dm. high, with little anthocyanin, pubescence medium ; plant hermaphrodite.

Leaves (average) 5·9 cm. long, 1·8 cm. broad, margin long ciliate, pubescent on both surfaces but hairs longer on upper surface.

Inflorescence with up to 50 flowers, more or less drooping ; bracts as in B.1 but eciliate.

Calyx shape as in B.1 or sometimes a little narrower ; with medium amount of anthocyanin.

Corolla with petals divided $\frac{2}{3}$ the length of the lamina, segments and petals not contiguous ; petals 2·1 cm. long, 8 mm. broad, with barely a boss ; corolla diam. 2·1 cm.

Filaments tinged pink ; anthers purple.

Immature seeds probably white. *Stigmata* pink.

Ripe capsules broadly ovoid-ellipsoid, 8 mm. long, 7 mm. diam. ; teeth 1·2 mm. long, erect ; mouth 2 mm. diam.

Carpophore 3 mm. long, 2·5 mm. diam.

Mature seeds weak armadillo.

B.4. *Habit* stems erect, up to 7 dm. long, with little anthocyanin, pubescent ; plant hermaphrodite.

Leaves (average) 6·1 cm. long, 2·2 cm. broad, margins long ciliate, hairs longer on the upper surface, colour dark green.

Inflorescence with up to 29 flowers, more or less drooping ; bracts as in B.1 but very sparingly ciliate.

Calyx narrow, with a trace of anthocyanin.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous ; petals 2·2 cm. long, 9 mm. broad, with a boss ; corolla diam. 2·1 cm.

Filaments pink ; anthers purple.

Immature seeds white. *Stigmata* pink.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 7·5 mm. long, 7·5 mm. diam. ; teeth 1·5 mm. long, erect ; mouth 2·5 mm. diam.

Carpophore 3 mm. long, 2·5 mm. diam.

Mature seeds weak armadillo.

B.5. *Habit* erect, stems up to 8·5 dm. high, with little anthocyanin, sparsely pubescent (few hairs) ; plant with hermaphrodite and female flowers.

Leaves (average) 5·8 cm. long, 2·1 cm. broad, margins long ciliate and with some crenulations, scattered hairs above, few scattered below.

Inflorescence with up to 50 flowers ; bracts as in B.1 but glabrous.

Calyx narrow, with a trace of anthocyanain.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous ; petals 1·9 cm. long, 8 mm. broad, with barely a boss ; corolla diam. 2 cm.

Filaments pink ; anthers purple.

Immature seeds pink. *Stigmata* very slightly tinged pink.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 8 mm. long, 8 mm. diam. ; teeth 2 mm. long, erect ; mouth 2 mm. diam.

Carpophore 2·5 mm. long, 2 mm. diam.

Mature seeds weak armadillo.

B.6. *Habit* erect, stems up to 6 dm. high, with little anthocyanin, glabrous ; plant female.

Leaves (average) 5·7 cm. long, 1·6 cm. broad, margins minutely crenulated, colour dark green.

Inflorescence with up to 80 flowers, more or less drooping, bracts as in B.1 but glabrous.

Calyx narrow, with little anthocyanin.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous, with barely a boss, segments very narrow ; petals 1·9 cm. long, 7 mm. broad ; corolla diam. 1·8 cm.

Immature seeds pink. *Stigmata* pink.

Ripe capsules broadly ovoid-ellipsoid, 9 mm. long, 7·5 mm. diam. ; teeth 1·5 mm. long, erect ; mouth 2·5 mm. diam.

Carpophore 2 mm. long, 2 mm. diam.

Mature seeds tubercled.

B.7. *Habit* erect, up to 5 dm. high, glabrous ; plant with hermaphrodite and female flowers.

Leaves (average) 5·9 cm. long, 2·1 cm. broad, margins crenulated, glabrous, green.

Inflorescence with up to 17 flowers, more or less drooping ; bracts as in B.1, ciliated.

Calyx shape as in B.1.

Corolla with petals divided $\frac{2}{3}$ length of lamina, segments and petals not contiguous, petals 1·7 cm. long, 7 mm. broad, with barely a boss ; corolla diam. 1·7 cm.

Filaments and anthers not scored.

Immature seeds pink. *Stigmata* pink.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 8 mm. long, 8 mm. diam. ; teeth 1·5 mm. long, erect, mouth 2 mm. diam.

Carpophore 2 mm. long, 2 mm. diam.

Mature seeds tubercled.

B.8. *Habit* stems erect, up to 7·5 dm. long, with little anthocyanin, glabrous ; plant with female and hermaphrodite flowers.

Leaves (average) 5·5 cm. long, 1·5 cm. broad, dark green, margins long ciliate or crenulated and then with few cilia, glabrous.

Inflorescence with up to 30 flowers, more or less drooping, bracts crenulate to ciliate.

Calyx shape as in B.1, with a trace of anthocyanin.

Corolla with petals divided ¾ length of lamina, segments and petals not contiguous, petals 1·9 cm. long, 9 mm. broad, with a small scale ; corolla diam. 2 cm.

Filaments pink ; anthers purple.

Immature seeds white. *Stigmata* pink.

Ripe capsules. Intermediate between broadly ovoid-ellipsoid and obloid types, 8 mm. long, 8 mm. diam. ; teeth 1·5 mm. long, erect ; mouth 2·5 mm. diam.

Carpophore 2 mm. long, 2 mm. diam.

Mature seeds weak armadillo.

B.9. *Habit* stems erect, up to 7·2 dm. long, with a trace of anthocyanin, glabrous.

Leaves (average) 6·2 cm. long, 1·6 cm. broad, margins crenulated, dark green, glabrous.

Inflorescence with up to 50 flowers ; bracts as in B.1, ciliated.

Calyx shape as in B.1, with a medium amount of anthocyanin.

Corolla with petals divided ¾ length of lamina, segments and petals not contiguous, petals 1·9 cm. long, 8 mm. broad, with a boss ; corolla diam. 2·2 cm.

Filaments pink ; anthers purple.

Immature seeds white. *Stigmata* tipped pink.

Ripe capsules broadly ovoid-ellipsoid, 8·5 mm. long, 7 mm. diam. ; teeth 2 mm. long, erect ; mouth 2 mm. diam.

Carpophore 2 mm. long, 2 mm. diam.

Mature seeds weak armadillo, verging very near to armadillo.

B.10. *Habit* stems erect, 9·5 dm. long, with a trace of anthocyanin and medium pubescence ; plant hermaphrodite.

Leaves (average) 5·7 cm. long, 1·9 cm. broad, pubescent on both surfaces but with a few more hairs below, long ciliate.

Inflorescence with up to 50 flowers, more or less drooping ; bracts as in B.1, ciliate.

Calyx shape as in B.1, with a trace of anthocyanin.

Corolla with petals divided ¾ length of lamina, segments and petals not contiguous, petals 1·9 cm. long, 9 mm. broad, with a boss ; corolla diam. 2 cm.

Filaments with the merest trace of pink ; anthers green.

Immature seeds pink. *Stigmata* white.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 7·5 mm. long, 7·5 mm. diam. ; teeth 1·5 mm. long, erect ; mouth 2·5 mm. diam.

Carpophores 2·5 mm. long, 2 mm. diam.

Mature seeds tubercled.

B.11. *Habit* stems erect, up to 6·8 dm. long, with a little anthocyanin, densely pubescent ; plant hermaphrodite and female.

Leaves (average) 5 cm. long, 1·8 cm. broad, pubescent on both surfaces.

Inflorescence with up to 70 flowers, more or less drooping, bracts as in B.1 with many long cilia.

Calyx shape as in B.1, with a trace of anthocyanin.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous, petals 2·3 cm. long, 1 cm. broad, with a well-developed boss ; corolla diam. 2·6 cm.

Filaments pink ; anthers purple.

Immature seeds white. *Stigmata* white.

Ripe capsules slightly obloid, 7 mm. long, 7·5 mm. diam. ; teeth 2 mm. long, erect ; mouth 2 mm. diam.

Carpophores 2 mm. long, 2 mm. diam.

Mature seeds tubercled.

B.12. *Habit* stems erect, up to 5·2 dm. long, with a little anthocyanin, glabrous ; plant hermaphrodite.

Leaves (average) 5·1 cm. long, 1·4 cm. broad, glabrous on both surfaces, margins minutely crenulate with a few cilia.

Inflorescence with up to 46 flowers, more or less drooping ; bracts as in B.1, not ciliated.

Calyx shape as in B.1, with a little anthocyanin.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous, petals 2·1 cm. long, 1·1 cm. broad, with a boss ; corolla diam. 2·2 cm.

Filaments pink ; anthers purple.

Immature seeds white. *Stigmata* pink.

Ripe capsules and *mature seeds* not collected.

B.14. *Habit* stems erect, up to 6·8 dm. long, with a little anthocyanin ; glabrous ; plant hermaphrodite.

Leaves (average) 6·8 cm. long, 2·1 cm. broad, margins crenulated and ciliate.

Inflorescence with up to 50 flowers ; bracts as in B.1, with few cilia.

Calyx shape as in B.1, with a trace of anthocyanin.

Corolla with petals divided $\frac{3}{4}$ length of lamina, segments and petals not contiguous, petals 1·9 cm. long, 8 mm. broad, with barely a boss, and a tinge of suffused colour at the base of the lamina on both surfaces ; corolla diam. 1·9 cm.

Filaments faintly tinged pink ; anthers purple.

Immature seeds white. *Stigmata* pink.

Ripe capsules not collected.

Mature seeds tubercled.

B.16. *Habit* stems erect, up to 3·8 dm. long, with little anthocyanin at the nodes only, glabrous ; plant female.

Leaves oblanceolate to oblong-obovate, (average) 3·8 cm. long, 1·0 cm. broad, glabrous, margins strongly ciliate, vivid green.

Inflorescence with up to 19 flowers ; bracts as in B.1, ciliated.

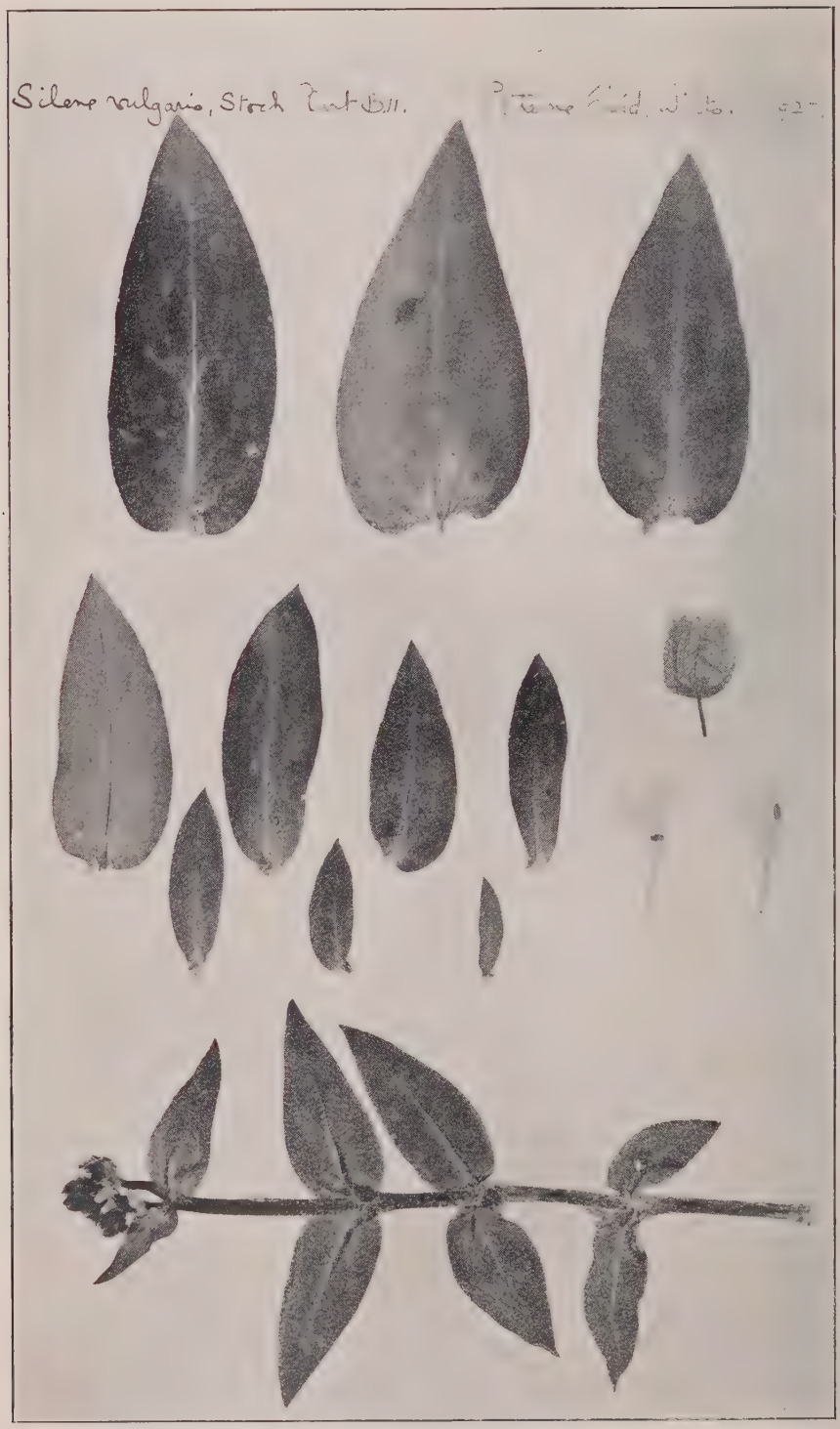
Calyx shape as in B.1, with a trace of anthocyanin.

PLATE VI

Silene vulgaris. Stock-Plant B. 1.

[*To face page* 122.

PLATE VII



Silene vulgaris. Stock-Plant B. 11.

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Corolla with petals divided $\frac{2}{3}$ length of lamina, segments and petals not contiguous, petals 1·6 cm. long, 7 mm. broad, with a boss ; corolla diam. 1·6 cm.

Immature seeds pink. *Stigmata* white.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 6 mm. long, 6 mm. diam. ; teeth 1·5 mm. long, erect ; mouth 2 mm. diam.

Carpophores 2 mm. long, 1·5 mm. diam.

Mature seeds tubercled, but verging strongly to weak armadillo.

B.18. *Habit* stems erect, up to 3·75 dm. long, with little anthocyanin, densely pubescent, plant hermaphrodite.

Leaves oblong to oblong-ovate, acute, (average) 3·8 cm. long, 1·0 cm. broad, margins long ciliate, pubescent on both surfaces, dark green.

Inflorescence with up to 17 flowers, bracts as in B.1, with very few cilia.

Calyx narrow, with little anthocyanin.

Corolla with petals divided $\frac{2}{3}$ length of lamina, segments and petals not contiguous, petals 1·8 cm. long, 6 mm. broad, with barely a boss ; corolla diam. 1·5 cm.

Immature seeds white. *Stigmata* white.

Ripe capsules intermediate between broadly ovoid-ellipsoid and obloid types, 7 mm. long, 7 mm. diam., teeth 1·5 mm. long, erect ; mouth 2 mm. diam.

Carpophores 3 mm. long, 2 mm. diam.

Mature seeds tubercled.

The plant appeared as a weed in the Experimental Grounds at Potterne in 1927.

Variations in the characters of S. vulgaris.

The introductory remarks given in our account of the character variations for *S. maritima* (*K.B.* 1929, p. 155) apply equally to the following account of *S. vulgaris*. The plant organs are dealt with below in the same general sequence as they have been for *S. maritima*.

Roots. The primary root-system of the seedling quickly penetrates the soil and branches tend to descend but often at a slightly less acute angle than in *S. maritima*. The tap-root may remain unbranched, except for small laterals, for several inches, or may fork into two or more main roots within an inch of the crown. The main roots penetrate into the soil and subsoil for a yard or more. From the upper portion of the root stock, usually numerous crowded buds arise and in the early part of the year grow out into erect or nearly erect shoots. The lower parts of the young shoots are more or less covered with decussate scale-leaves, formed from entire leaf-promordia and passing upwards into typical young foliage leaves. The scale-leaves below ground level are yellowish in colour, but above have an increasing chlorophyll content often masked by a considerable amount of anthocyanin. Root-stocks largely deprived of their

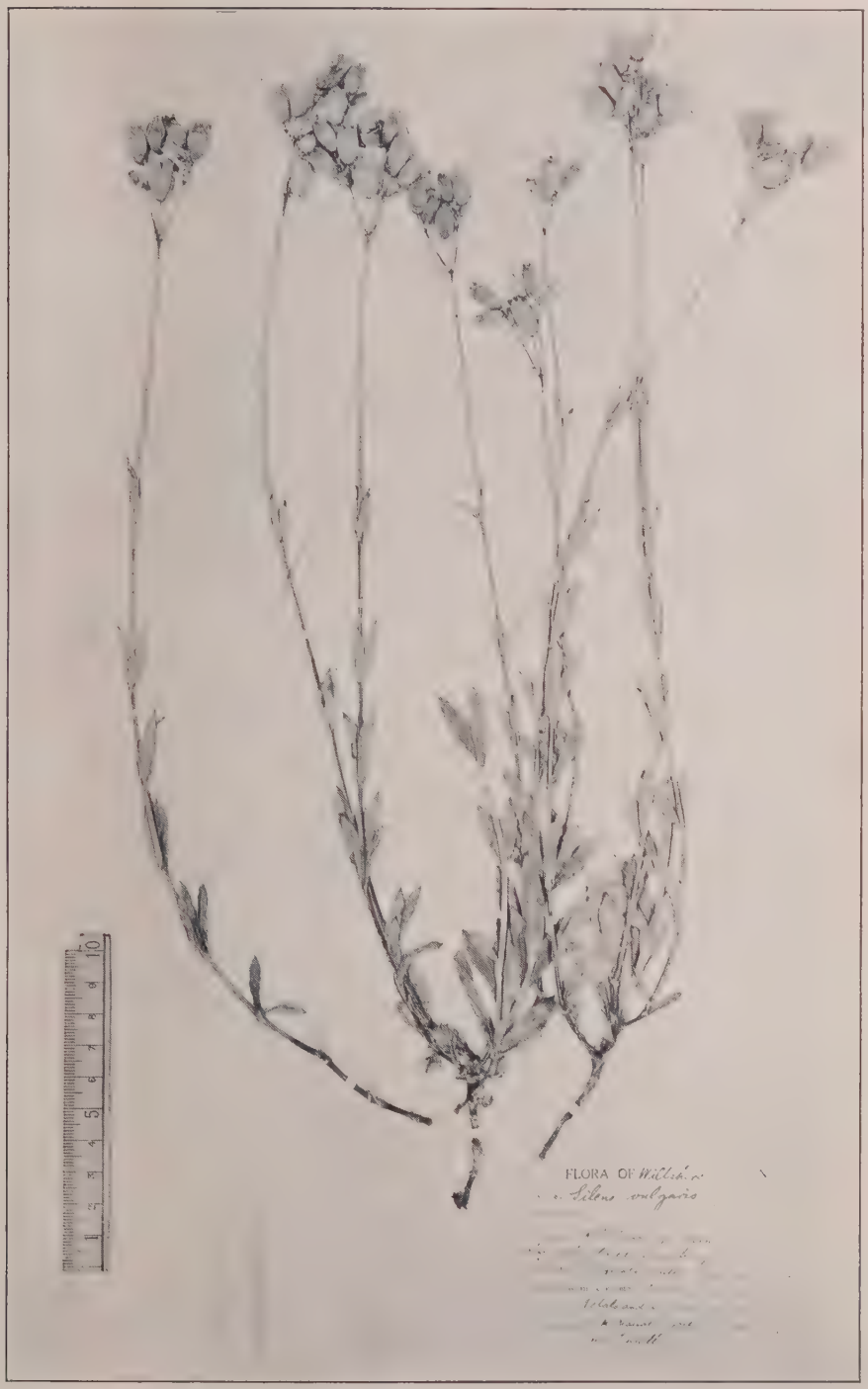
main roots and with the aerial parts well cut back transplant easily and successfully. *S. vulgaris* propagates vegetatively from older roots much more readily than does *S. maritima*. This gives the species a decided advantage in such a habitat as arable land, where ploughing not only disturbs the plants but cuts up the roots. This was well exemplified in our studies of the population on Potterne Field where the arable soil is a stiff marly clay derived from the Lower Chalk. Most of the plants here were growing from old cut roots whose adventitious buds had given rise to strong stems bearing well-developed leaves and inflorescences.

Stems. The main stems are erect or ascending. When growing in shade, as under hedges, or amongst tall herbaceous or shrubby vegetation, the stems become slender, the internodes elongated, and the plant straggling. Thus material collected between Felden and Chipperfield, Herts, 10.6.28, growing on a shady hedge bank, had stems up to 11 dm. long, with middle internodes 10–11 cm. and 14 nodes, as contrasted with material collected north of Chipperfield on the same date in a grass field, with stems up to 4·6 dm. long, middle internodes 4–5 cm. long, and 7 nodes. The lower nodes in the shade-growing plants were close together. Age and habitat certainly modify stem length very greatly. Stem height in addition to being increased by surrounding vegetation is reduced by compactness of soil, while in cultivated soil the stems are taller and more robust. This is well shown in samples of the population at All Cannings, Wilts (see p. 137). Thus on the open grassy downland which had not been recently cultivated the plants were relatively dwarf, but healthy, with a minimum height of 2·5 dm. Around the edges on newly disturbed soil the plants attained a height of 7·4 dm., had thicker stems, and often suffered more from *Marssonina*. The terete, hollow or slightly hollow internodes at about the middle of mature stems average 4·5 cm. long and 3 mm. in diameter. The solid nodes average 3·5 mm. in diameter. We have never found adventitious roots arising at the nodes either in nature or in cultivation.

A peculiar " strict " habit has frequently been observed in wild populations. The plants showing it are generally of or below medium stature, have slender wiry stems, and the relatively narrow and acute leaves tend to stand erect at an acute angle from the nodes, thus hiding the internodes. Strict plants are much more frequent on permanent pastures than on arable land. Thus they are very common on the grass down at All Cannings, Wilts, common at Bradfield, Berks., in permanent pasture, and very rare in the arable Potterne Field, Wilts. We have also found strict plants in Kent, Hampshire, and Surrey. Variations towards the strict habit have been recorded in the Transplant experiments [see Journ. Ecol. xviii. 362 (1930)].

Plants occur absolutely devoid of anthocyanin both in the vegetative and floral parts (as Nos. 16 and 57 from All Cannings),

PLATE VIII



Silene vulgaris. All Cannings Farm, Devizes. No. 1, to show strict habit.

[*To face page* 124.

PLATE IX

Silene vulgaris on Thames bank near Old Windsor, No. 4, to show not strict habit.

To face page 125.]

while the other extreme is shown by plants with a considerable amount of anthocyanin in the vegetative parts (Nos. 81 and 82 from All Cannings) or in the calyx (No. 94). We have, however, never seen an amount comparable with that in the narrow-leaved plants of *S. maritima* from the Portland end of the Chesil Beach. If factors are present for anthocyanin development there is usually a greater development in the vegetative parts after frost, drought, or disease attack.

Indumentum. Unlike *S. maritima* there is a considerable range in development of hairs in *S. vulgaris*. We have been able to score all the plants examined, both wild and those bred under control, into four groups, with stock-plants as standards.

1. Densely pubescent, as stock-plant B.11.
2. Medium amount of pubescence as stock-plant B.10.
3. Few scattered hairs as stock-plant B.5.
4. Glabrous as stock-plant B.1.

The presence or absence of indumentum has a genetical basis, the pubescent being dominant over the glabrous condition. It is equally certain that modifying factors cause the appearance of plants differing in degree of pubescence. Our groups 1, 3, and 4 are very distinct from one another, but links between groups 1 and 2, and 2 and 3, are sometimes found. The stem pubescence, when present, is most dense a few internodes above the base and ends completely below the last pair of foliage leaves. We have never seen pubescence in the inflorescence region or on the calyx. When present on the stem pubescence is also found on the leaves, normally on both surfaces.

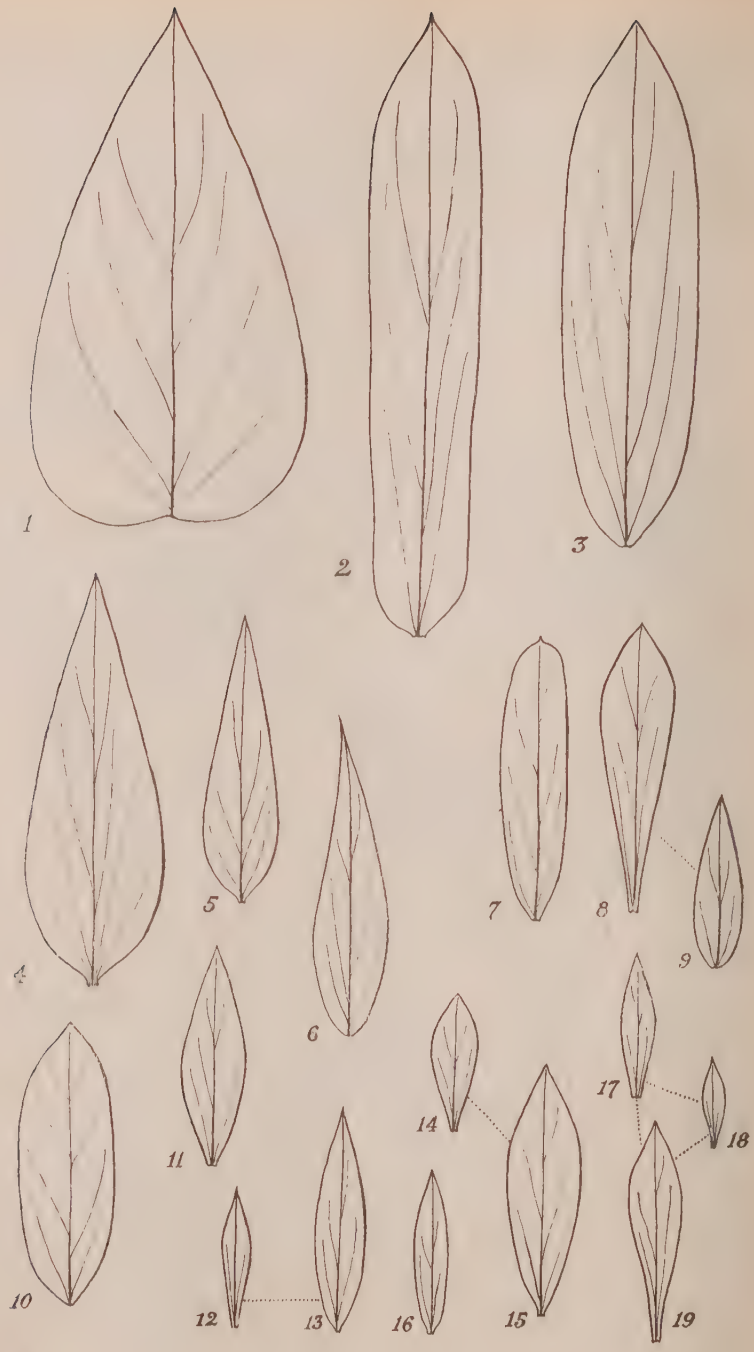
The following figures from wild populations are probably common averages :

Bradfield, Berks	hairy 20	glabrous 80	=1:4.
All Cannings Farm, Wilts ...	,, 62	,, 38	=1·6:1

The absence of *barren shoots* in *S. vulgaris* and its significance has been considered in a previous paper (*K.B.* 1929, pp. 156 seq.).

LEAVES. *General.* As in *S. maritima*, although the leaves on an individual plant show a large amount of fluctuation, the general leaf shape of a plant is a scorable character. We do not at present know the limits of plasticity of gene expression or the degree of gene interaction for leaf shape and size, but we know genes are involved. In our measurements we give the size of average well-developed leaves, unless we state to the contrary.

Shape. A central outline shape is from broadly lanceolate or ovate-lanceolate to narrowly elliptic. In all leaf shapes the apex is acute to acuminate-acute in the narrower ones. There is a slight apiculus and sometimes the blade is slightly "pinched in" just below the apex. The lower leaves are narrowed to the base and the upper ones, especially when the blades are broader, are slightly or markedly amplexicaul. Shape variations include linear (Old Windsor No. 7), lanceolate (Old Windsor No. 6) and lanceolate-ovate (Old Windsor No. 4).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Size. Stock-plant B.1 has leaves of a very good medium standard, measuring 4·5 cm. long and 1·2 cm. broad. We propose to use the following terms for leaf size :

Leaves " very long," 10–8 cm.
Leaves " long," 8–6 cm.
Leaves " medium length," 6–4 cm.
Leaves " short," 4–2 cm.
Leaves " very short," less than 2 cm.
Leaves " very broad," 4–3 cm.
Leaves " broad," 3–2 cm.
Leaves " medium breadth," 2–1 cm.
Leaves " narrow," 1–0·5 cm.
Leaves " very narrow," less than 0·5 cm.

The above classes are based on the whole of the material of the species we have examined, extra-British as well as the British specimens and populations considered in this paper.

Margin. A very narrow membranous margin surrounds the leaf. It often runs out into distinct cilia, especially in pubescent plants.

Texture. The leaf texture is less succulent as shown by the thickness relative to the superficial area of the leaf than in *S. maritima*. Shade-grown plants have more flaccid leaves than those grown in the open.

Colour. The colour of the foliage shows a great range in wild populations. Plants with green, dark-green, and yellowish-green leaves are distinguishable, but intermediates occur and it is difficult to say how far the apparent chlorophyll colours are due to masking by anthocyanin. Some plants show the leaves, or often only some of them, deeply coloured with purple anthocyanin. Young shoots early in the year have frequently much anthocyanin but later develop normal green leaves.

Inflorescence. The flowers are more or less drooping when in bloom and number from a minimum of 5 to a maximum of 80 on each inflorescence; an average number is 20 for a fully developed inflorescence. We regard the numerous drooping flowers as a general specific character. Most of the bracts are at first green-herbaceous, many becoming scarious later. On the whole they are more scarious than in *S. maritima*. Their surfaces are glabrous but the margin may be eciliate, crenulate, or markedly ciliate, varying even on the same plant.

Figs. 1-19. To show range of size and shapes of leaves in *Silene vulgaris*, British material only. All natural size.

1. Thames bank near Old Windsor, No. 4. 2. Thames bank near Old Windsor, No. 7. 3. Bryn-yt-eithen, Cardiganshire, No. 2034. 4. Between Felden and Chipperfield, Herts, No. 2. 5. Thames bank near Old Windsor, No. 5. 6. All Cannings Farm, Wilts, No. 35. 7. All Cannings Farm, Wilts, No. 55. 8 and 9. Thames bank near Old Windsor, No. 6. 10. All Cannings Farm, Wilts, No. 64. 11. All Cannings Farm, Wilts, No. 78. 12 and 13. All Cannings Farm, Wilts, No. 2. 14 and 15. All Cannings Farm, Wilts, No. 42. 16. Barton Stacey, Hants, No. 7. 17, 18, and 19. Barton Stacey, Hants, No. 6.

Flowers. The drooping of the flowers is correlated with a slight degree of zygomorphy. This is due to the longer claws of the petals on the side towards which the flower droops. The expanded limbs as a whole slope backwards from the drooping side and the upper petals may even be reflexed. No zygomorphy has been detected in the calyces.

The flowers are quite strongly scented in the evening and the odour is particularly noticeable when the plants are massed. Pollination studies have not yet been made, but both diurnal and nocturnal insects have been observed visiting the flowers.

Anthocyanin may occur in any or all of the floral organs or may be entirely absent. The degree of intensity of colouration has a wide range of fluctuation between different plants or even different floral organs of the same plant. Usually, except for particular plants and for calyces, we have scored for presence or absence and not for degree of anthocyanin development.

Calyx. Both in the flowering and in the fruiting conditions there is considerable range in calyx shape. After many attempts we have scored flowering calyces into three groups, inflated, subinflated, and narrow. The first and last are very distinct but there is a continuous series in the middle group linking the end groups together. In the fruiting condition the calyx shape depends partly on the size and shape of the capsule and also on the length of the carpophore.

In some populations, as those studied on the Hog's Back, near Guildford, two extreme types of fruiting calyx can be picked out, (*a*) with calyces loosely fitting round the fruit, much inflated, often large and drying more or less white, (*b*) with calyces tightly fitting round the fruit, stiffer, smaller, and often drying darker (to a distinct

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Silene vulgaris. Figs. 20-23. To show types of indumentum, x 2.

Fig. 20. Dense, Little Tree Field, Potterne, Wilts, No. 7. Fig. 21. Medium, Stock-Plant 10. Fig. 22. Few hairs, Stock-Plant 5. Fig. 23. Glabrous, near Tentsmuir, Fifeshire.

Figs. 24-26. To show types of calyx-shape, x 2.

Fig. 24. Inflated, All Cannings Farm, Wilts, No. 42. Fig. 25. Subinflated, All Cannings Farm, Wilts, No. 88. Fig. 26. Narrow, All Cannings Farm, Wilts, No. 39.

Figs. 27-31. To show petal characters, x 2 except Fig. 31 which is x 25.

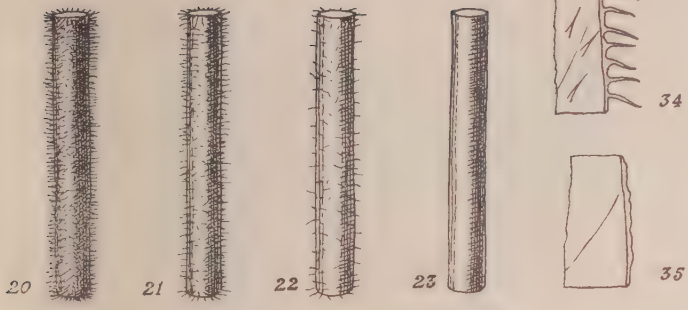
Fig. 27. Short narrow petal, more than $\frac{3}{4}$ lobed, segments not overlapping, scarcely a boss present, All Cannings Farm, Wilts, No. 1. Fig. 28. Long broad petal, more than $\frac{3}{4}$ lobed, segments overlapping, margin slightly crenulate, boss present, All Cannings Farm, Wilts, No. 11. Fig. 29. Short narrow petal, $\frac{2}{3}$ lobed, segments not overlapping, scarcely a boss present, All Cannings Farm, Wilts, No. 39. Fig. 30. Long broad petal, scarcely $\frac{3}{4}$ lobed, segments not overlapping, bifid scale present, All Cannings Farm, Wilts, No. 88. Fig. 31. Bifid scale of Fig. 30, x 25.

Figs. 32-33. To show extremes of capsule shapes, x 2.

Fig. 32. Type I., Hog's Back, No. 7. Fig. 33. Type II., Hog's Back, No. 4.

Figs. 34-35. To show extreme types of leaf-margins, x 12.

Fig. 34. Ciliate, All Cannings Farm, Wilts, No. 39. Fig. 35. Not ciliate, Thames bank near Old Windsor, No. 4.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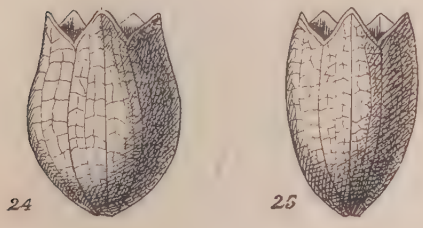
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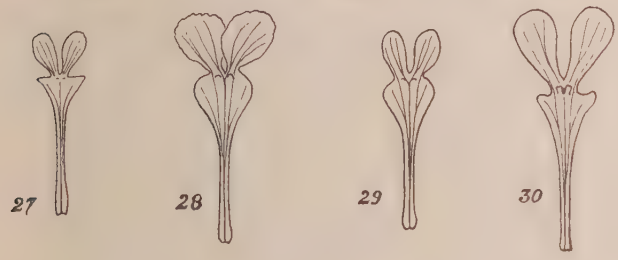
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brown), than in (*a*). On the whole mature (fruiting) calyces are the same for all fruits on each plant. The large number of items intermediate between (*a*) and (*b*) may be due partly to hybridization and partly to plasticity of the character.

Corolla. In general the petals are smaller than in *S. maritima*, though it is possible to find exceptions, and the range of size and shape is less in our present experience.

Petal length. This ranges from 1 to 2·3 cm. and we propose to term petals measuring 1·5 cm. and over " long " and petals measuring 1·4 cm. and below " short."

Petal breadth. This ranges from 0·3 cm. to 1·0 cm., and we propose to term petals measuring 0·6 cm. and over " broad " and those 0·5 cm. and below " narrow " (measurements being taken to the nearest mm.). Petal breadth and, less markedly, petal length tend to increase under cultivation.

Shortness and narrowness of petals are correlated in a high degree with femaleness of the flower.

Petal lobing. Normally the blade of each petal is bilobed for $\frac{3}{4}$, or more, or approximately $\frac{2}{3}$, of its length and has two slightly raised bosses (or a two-lobed boss). Exceptions (though not extreme ones) occur. Thus stock-plant B.8 has two small scales on each petal. The depth of lobing is measured from the level of the shoulders, which may be straight or rounded. Up to the present we have observed no plants with extra lateral lobes comparable with the *forma lobata* Salisbury of *S. maritima*, though such have been recorded by other authors. The margins of the lobes may be quite entire or distinctly crenulate. Both the normal two lobes and the petals are most often not contiguous or overlapping in the mature flower in the sense in which they are in some plants of *S. maritima*. One or two pairs of petals or segments in individual flowers may be in contact in connection with the degree of zygomorphy. It should be noted that scoring for many corolla characters must be done in the evening when the flowers are fully expanded; there is then no difficulty in scoring the plant as a whole for these characters.

Anthocyanin blotch. This is not of such frequent occurrence as in *S. maritima* but we have found the character in a few individuals in wild populations in Wiltshire. Pink flowered plants in otherwise typical *S. vulgaris* have not yet been studied as living plants.

Androecium (and sex). In the wild populations we have studied the majority of plants were hermaphrodite, but entirely female plants are not infrequent. Often female and hermaphrodite flowers may be found in the same individual. Plants with white and others with pink filaments occur in all large populations. The anthers also vary in colour from pure green to deep purple; the colour is particularly pronounced along the lines of dehiscence and the connective.

Gynaeceum. *Stigmata colour.* Plants with purplish and others with colourless stigmata occur in the wild.

Colour of immature seeds. In *S. vulgaris* the majority of plants have white immature seeds, but plants with pink immature seeds occur in large wild populations. The following figures from random samples of wild populations are probably fair averages :—

Bradfield, Berks ...	...	white	32	pink 8	=4:1
All Cannings Farm, Wilts ...		,,	244	,, 68	=3·6:1

Fruits. For *shape* of capsule we have scored the items into two main classes : I broadly ovoid-ellipsoid and II broadly ovoid to obloid. Intermediates undoubtedly occur, though they are more frequent in some populations and generations than in others. The former are the more elongated and taper slightly in the upper part. The latter are as broad as or broader than long and taper very little or not at all in the upper part.

The size and, to a less degree, the shape of the capsule is influenced by :—

1. The vigour of the plant.
2. The vigour of the inflorescence.
3. The position of the flower on the inflorescence (lower flowers have larger and broader capsules than higher ones, on the whole).
4. The number of seeds maturing in the capsule.
5. The degree of development reached when the capsule ripens and opens (this is partly correlated with 3, since the upper flowers usually mature their capsules more quickly than the lower).
6. Accidents, as insect bites and *Marssonina*.
7. Shape of the calyx.
8. Length of the carpophore.
9. Hermaphroditism or femaleness.

The *carpophore* varies in length from 2 to 3 mm. and in breadth from 1·5 to 2·5 mm.

The *capsule teeth* are normally 6 and these are hygroscopic and erect or nearly so.

Mature, open, dried capsules, with the calyces removed, may be caused to close their teeth completely :—

1. by soaking in cold water ; the teeth then close gradually in about 45 minutes ; and
2. by placing in water and bringing this to boiling point ; the teeth then close immediately.

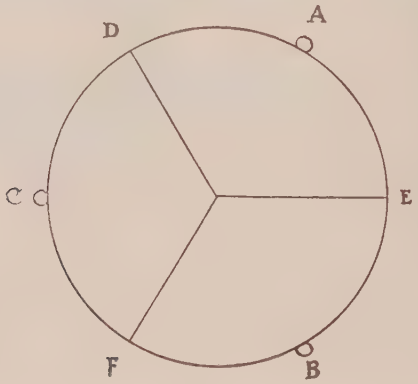
The shape of the closed, but ripe, capsule can be judged excellently in this manner. In both 1 and 2 the teeth re-open gradually as the capsules dry, in ordinary summer room temperature in about 4 to 10 hours, or immediately on drying in a tin over gas.

To study the length, shape, degree of reflexing of the capsule teeth, and the diameter of the mouth, mature capsules are essential. Also, from the above observations, moisture is obviously a factor in degree of reflexing, and all items must be examined under the same degree of humidity.

One other matter deserves comment. One, several, or all of the teeth may retain portions of the styles. Since there are most often three styles (though individual flowers may have 4 or 5), most often 3 of the teeth have style remnants. These style remains must be ignored in considering the reflexing of the teeth, the outward curvature of the teeth proper alone being considered.

The number of capsules occurring with more than six teeth and 3 loculi (i.e. capsules composed of more than three carpels) is smaller relative to the total number examined than in *S. maritima*, but actual figures have not been obtained. The only capsule found (in either species) which was composed of only two carpels (four teeth, two loculi) occurred in stock-plant B.6. At least three capsules were read under each number in all scorings of capsule characters.

As a rule the teeth on either side of a septum are the last to split. Thus in the diagram : ABC represent the position of the styles in the ovary, and DEF the positions of the septa. The splits usually occur at ABC before occurring at DEF. One example of the reverse was, however, seen in a capsule from the Hog's Back.



The characteristic number of teeth is 6 and this number was found on at least some capsules on all plants examined. When only 5 teeth are present, two, usually on either side of a septum, have failed to split. When 7 or 8 are present 4 carpels form the fruit as is shown by the 4 septa, and all the teeth are formed or 2 fail to split apart.

Since the number of teeth is definitely correlated with the number of loculi, and is indeed merely one expression of this, it must have the same basic cause as that which gives 2, 3, 4, (or 5) loculi. Since the locular number varies on the same plant the cause is not a genetic one comparable, for example, with that producing armadillo seeds.

The teeth of the normally mature capsule are usually erect, relative to the strongly recurved teeth of *S. maritima*. Actually there is a slight curving outwards, very rarely is recurving obvious.

Out of the 100 plants whose fruits were collected from the Hog's Back, Guildford (see p. 142), two (Nos. 12, 32) had reflexed teeth, but in neither was the reflexing so great as is normal in *S. maritima*, though for this character again it is possible to obtain a continuous series from the usual fruit type in one species to the usual fruit type in the other.

The width of the capsule mouth is partly, but very imperfectly, correlated with the reflexing of the teeth and the shape of the capsule. The broader capsules show a tendency to have more curved teeth and wider mouths. The samples from the Hog's Back referred to in the previous paragraph were arranged as follows for width of capsule mouth (out of 100 items one was not scorable) :—

(*a*) very narrow mouths (1–1·5 mm. diam.), 5.
(*b*) mouths 1·6 to 2·3 mm. diam., 18.
(*c*) mouths 2·4–2·6 mm. diam., 46.
(*d*) mouths 2·7–2·9 mm. diam., 20.
(*e*) broad mouths 3 mm. or (rarely) more diam., 10.

Mature Seeds. As for *S. maritima* we recognize four classes of seed pattern—armadillo, weak armadillo, tubercled, and strongly tubercled. Figures of these types (for *S. maritima*) were published in *K.B.* 1929, p. 174.

Counts of seeds from single capsules.

F_1 from stock-plant 1 selfed.

49 good 22 bad : 43 good 28 bad : 31 good 39 bad : 34 good 29 bad : 32 good 33 bad : 37 good 24 bad : 34 good 24 bad : 36 good 23 bad : 17 good 33 bad : 37 good 31 bad : 46 good 30 bad.

Range of total seeds from 50 to 76 per capsule.
Range of good seeds from 49 to 17 per capsule.
Range of bad seeds from 39 to 22 per capsule.
Average number of good seeds per capsule 36.
Average number of bad seeds per capsule 29.

Stock-plant 2.

51 good 22 bad : 59 good 30 bad : 45 good 32 bad : 72 good 22 bad : 52 good 47 bad : 36 good 24 bad : 50 good 31 bad : 54 good 27 bad : 27 good 29 bad : 6 good 52 bad : 42 good 26 bad.

Range of total seeds from 56 to 99 per capsule.
Range of good seeds from 6 to 72 per capsule.
Range of bad seeds from 22 to 52 per capsule.
Average number of good seeds per capsule 45.
Average number of bad seeds per capsule 31.

Stock-plant 3.

61 good 37 bad : 53 good 10 bad : 65 good 43 bad : 93 good 19 bad : 62 good 46 bad : 94 good 20 bad : 47 good 52 bad : 45 good 53 bad : 65 good 27 bad : 66 good 25 bad : 70 good 21 bad : 65 good 25 bad : 97 good 22 bad : 82 good 16 bad.

Range of total seeds from 63 to 119 per capsule.

Range of good seeds from 45 to 97 per capsule.
Range of bad seeds from 10 to 53 per capsule.
Average number of good seeds per capsule 69.
Average number of bad seeds per capsule 30.

Stock-plant 4.

18 good 83 bad : 78 good 42 bad : 49 good 95 bad : 51 good 80 bad : 84 good 37 bad : 28 good 98 bad : 70 good 29 bad : 18 good 86 bad : 72 good 43 bad : 99 good 25 bad : 76 good 32 bad : 98 good 34 bad.

Range of total seeds from 99 to 144 per capsule.
Range of good seeds from 18 to 99 per capsule.
Range of bad seeds from 25 to 98 per capsule.
Average number of good seeds per capsule 62.
Average number of bad seeds per capsule 57.

Stock-plant 5.

64 good 39 bad : 50 good 35 bad : 59 good 17 bad : 66 good 20 bad : 49 good 32 bad : 63 good 27 bad : 29 good 73 bad : 68 good 33 bad : 26 good 70 bad : 64 good 18 bad : 49 good 31 bad : 52 good 38 bad : 47 good 57 bad.

Range of total seeds from 76 to 104 per capsule.
Range of good seeds from 26 to 68 per capsule.
Range of bad seeds from 17 to 73 per capsule.
Average number of good seeds per capsule 53.
Average number of bad seeds per capsule 38.

Stock-plant 6.

53 good 34 bad : 88 good 12 bad : 65 good 25 bad : 70 good 25 bad : 86 good 16 bad : 78 good 28 bad : 72 good 23 bad : 50 good 29 bad : 54 good 28 bad : 85 good 12 bad : 61 good 23 bad : 70 good 20 bad.

Range of total seeds from 79 to 106 per capsule.
Range of good seeds from 50 to 88 per capsule.
Range of bad seeds from 12 to 34 per capsule.
Average number of good seeds per capsule 69.
Average number of bad seeds per capsule 23.

Stock-plant 8.

71 good 12 bad : 58 good 28 bad : 69 good 24 bad : 28 good 51 bad : 59 good 30 bad : 61 good 20 bad : 60 good 27 bad : 52 good 33 bad : 50 good 20 bad : 70 good 31 bad : 66 good 30 bad : 78 good 15 bad.

Range of total seeds from 70 to 101 per capsule.
Range of good seeds from 28 to 78 per capsule.
Range of bad seeds from 12 to 51 per capsule.
Average number of good seeds per capsule 60.
Average number of bad seeds per capsule 27.

Stock-plant 9.

78 good 22 bad : 91 good 31 bad : 77 good 32 bad : 68 good 34 bad : 34 good 58 bad : 74 good 15 bad. 74 good 10 bad : 47 good 34 bad : 97 good 21 bad : 89 good 17 bad ; 51 good 28 bad : 24 good 74 bad : 77 good 24 bad.

Range of total seeds from 79 to 122 per capsule.
Range of good seeds from 24 to 97 per capsule.
Range of bad seeds from 10 to 74 per capsule.
Average number of good seeds per capsule 68.
Average number of bad seeds per capsule 31.

Stock-plant 10.

50 good 44 bad : 56 good 32 bad : 44 good 20 bad : 52 good 54 bad : 38 good 54 bad : 85 good 24 bad : 47 good 33 bad : 70 good 20 bad : 43 good 60 bad : 53 good 43 bad : 62 good 38 bad : 62 good 41 bad : 72 good 36 bad.

Range of total seeds from 64 to 109 per capsule.
Range of good seeds from 38 to 85 per capsule.
Range of bad seeds from 20 to 60 per capsule.
Average number of good seeds per capsule 56.
Average number of bad seeds per capsule 38.

Stock-plant 11.

56 good 42 bad : 46 good 29 bad : 90 good 18 bad : 55 good 47 bad : 51 good 45 bad : 67 good 28 bad : 42 good 47 bad : 34 good 53 bad : 61 good 40 bad : 48 good 41 bad : 51 good 21 bad : 84 good 9 bad.

Range of total seeds from 72 to 108 per capsule.
Range of good seeds from 34 to 90 per capsule.
Range of bad seeds from 9 to 53 per capsule.
Average number of good seeds per capsule 57.
Average number of bad seeds per capsule 35.

Stock-plant 14.

38 good 39 bad : 39 good 44 bad : 36 good 48 bad : 32 good 46 bad : 41 good 31 bad : 20 good 44 bad : 26 good 55 bad : 52 good 41 bad : 43 good 37 bad : 58 good 37 bad.

Range of total seeds from 64 to 95 per capsule.
Range of good seeds from 20 to 52 per capsule.
Range of bad seeds from 31 to 55 per capsule.
Average number of good seeds per capsule 38.
Average number of bad seeds per capsule 42.

Stock-plant 16.

49 good 21 bad : 45 good 28 bad : 22 good 58 bad : 42 good 51 bad : 36 good 28 bad : 62 good 14 bad : 67 good 6 bad : 40 good 32 bad : 36 good 22 bad : 51 good 13 bad.

Range of total seeds from 58 to 93 per capsule.
Range of good seeds from 22 to 67 per capsule.
Range of bad seeds from 8 to 58 per capsule.
Average number of good seeds per capsule 45.
Average number of bad seeds per capsule 28.

For the whole of the collections examined :—

Number of capsules 143 from 12 plants.
Range of total seeds from 50 to 144 per capsule.
Range of good seeds from 6 to 99 per capsule.
Range of bad seeds from 8 to 98 per capsule.

Average number of good seeds per capsule 56.
Average number of bad seeds per capsule 34.
Note.—High numbers in plants 3, 4, 6, 9.
Low numbers in plants 1 (F_1), 2, 14, 16.

Intra-specific variation.

In our third paper of this series (*Kew Bull.* 168, 1929) we discussed systems of intra-specific classification for *Silene* and devised a scheme for symbolizing characters in *S. maritima*. The scheme proved so useful that it was later applied, with the necessary modifications, to *S. vulgaris*.

Up to the stage at which our researches have arrived the following letter and figure symbols are needed* for intra-specific variation in *S. vulgaris*.

H.1=habit strict.
2=habit not strict.
I.1=indumentum of dense pubescence.
2=indumentum of medium pubescence.
3=indumentum of few hairs.
4=indumentum absent (glabrous except for marginal cilia to the leaves).
L.1=leaves very long, *i.e.*, 8 or more cm. in length.
2=leaves long, *i.e.*, 8 to 6 cm. in length.
3=leaves of medium length, *i.e.*, 6 to 4 cm. long.
4=leaves short, *i.e.*, 4 to 2 cm. long.
5=leaves very short, *i.e.*, less than 2 cm. long.
6=leaves very broad, *i.e.*, 4 or more cm. in breadth.
7=leaves broad, *i.e.*, 4 to 2 cm. in breadth.
8=leaves of medium breadth, *i.e.*, 2 to 1 cm. broad.
9=leaves narrow, *i.e.*, 1–0·5 cm. broad.
10=leaves very narrow, *i.e.*, less than 0·5 cm. broad.
11=leaves with much anthocyanin.
12=leaves with some anthocyanin.
13=leaves with no anthocyanin.
K.1=calyx inflated.
2=calyx subinflated.
3=calyx narrow.
4=calyx with much anthocyanin.
5=calyx with some anthocyanin.
6=calyx with no anthocyanin.
C.1=petals long, *i.e.*, 1·5 cm. or more in length.
2=petals short, *i.e.*, less than 1·5 cm. in length.
3=petals broad, *i.e.*, 6 mm. or more in breadth.
4=petals narrow, *i.e.*, less than 6 mm. in breadth.
5=petals bilobed.
6=petals multilobed.
7=petals overlapping or contiguous.

*Not all characters were scored in every population studied.

8=petals not overlapping or contiguous.
9=petal lobes overlapping or contiguous.
10=petal lobes not overlapping or contiguous.
11=anthocyanin blotch present.
12=anthocyanin blotch not present.
13=petal lamina lobed $\frac{3}{4}$.
14=petal lamina lobed $\frac{2}{3}$.
A1=functional stamens present (flowers hermaphrodite).
2=functional stamens absent (flowers female).
3=filaments purplish.
4=filaments colourless (white).
5=anthers purple or with purple colouration.
6=anthers without purple colouration.
G.1=stigmata purplish.
2=stigmata colourless (white).
3=immature seeds pink (purplish).
4=immature seeds colourless (white).
F.1=capsules broadly ovoid-ellipsoid.
2=capsules ovoid to obloid.
Se.1=mature seeds armadillo.
2=mature seeds weak armadillo.
3=mature seeds tubercled.
4=mature seeds strongly tubercled.

Studies on wild populations.

Chalk Down, enclosed as part of All Cannings Farm, Devizes, Wilts, 5.7.29.

This downland is at an altitude of between 500 and 600 feet about half a mile north-east of All Cannings Farm, 5 miles east by north of Devizes. The area is the end of a chalk down and slopes to the south-west and the south-east. The field is usually mown for hay, but in 1929, owing to the drought in the first half of the year, the crop was too poor to cut. The southern half was last ploughed in 1924, the northern half not since 1919. *Silene* plants were scattered equally throughout the field. Amongst the grass the *Silene* plants were shallow rooted and of rather dwarf stature, but at the edges the plants were tall, robust, many-stemmed, and more deeply rooted, and here the grasses and general vegetation were much coarser. A majority of the Silene individuals were hairy and there were a number of conspicuous individuals with no anthocyanin in the calyx or other parts of the plant. Adjacent to a field of oats on the south a considerable number of plants were badly infected with *Marssonina*. The *Silene* population ended abruptly to the south, none occurring amongst the oats. The open down to the west was also devoid of *Silene* and there is no evidence that it has ever been under the plough or in other ways disturbed.

The most conspicuous species in the field, apart from *Silene vulgaris*, were: *Cynosurus cristatus* Linn., *Holcus lanatus* Linn.,

Trisetum flavescens Pal. de Beauv., *Dactylis glomerata* Linn., *Bromus hordeaceus* Linn., *Briza media* Linn., *Plantago lanceolata* Linn., *Centaurea Scabiosa* Linn., *Chrysanthemum Leucanthemum* Linn., *Thymus Serpyllum* Linn., *Galium verum* Linn., *Linum catharticum* Linn., *Trifolium repens* Linn., *T. pratense* Linn., *T. hybridum* Linn., *Anthyllis Vulneraria* Linn., *Lotus corniculatus* Linn., *Onobrychis viciaefolia* Scop., *Medicago lupulina* Linn., *Potentilla Anserina* Linn., *Gymnadenia conopsea* Br., *Ophrys apifera* Huds., *Scabiosa Columbaria* Linn., *Leontodon hispidum* Linn., *Daucus Carota* Linn., *Lolium perenne* Linn., *Phleum pratense* Linn., *Agrostis alba* Linn., *Asperula cynanchica* Linn., *Reseda lutea* Linn., *Linaria vulgaris* Mill., *Cirsium arvense* Scop., and *Ranunculus arvensis* Linn.

In addition to the sample analyzed below for vegetative and floral characters, different random samples were scored for certain characters with the following results :—

1. *Indumentum* : 100 plants. 62 hairy, 38 glabrous.
2. *Colour of immature seeds*. 312 plants, 68 purplish, 244 white.
3. *Mature seeds* : 163 plants. 4 armadillo, 44 weak armadillo, 95 tubercled, 20 strongly tubercled.
4. *Capsules* : the same 163 plants. 96 type I, 25 type II, 42 intermediate.

No. 1.	H.1.	I.4.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.2.
No. 2.	H.1.	I.2.	L.4.9.12.	K.2.4.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 3.	H.1.	I.4.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.1.3.
No. 4.	H.1.	I.2.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 5.	H.1.	I.4.	L.3.9.12.	K.1.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 6.	H.1.	I.2.	L.3.9.12.	K.2.5.	C.2.4.5.8.10.11.13.	A.1.3.	G.2.3.
No. 7.	H.1.	I.3.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 8.	H.1.	I.2.	L.3.8.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 9.	H.1.	I.4.	L.3.9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.4.
No. 10.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.2.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 11.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.3.5.8.9.11.13.	A.1.3.	G.1.3.
No 12.	H.1.	I.4.	L.3–4.9.12.	K.1.5.	C.1.4.5.8.10.11.13.	A.1.3.	G.1.4.
No. 13.	H.1-2.	I.2.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.4.
No. 14.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.2.3.5.8.10.11.13.	A.1.3.	G.1.3.
No. 15.	H.1-2.	I.4.	L.4.9.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.4.	G.2.4.
No. 16.	H.1-2.	I.2.	L.4.9.12.	K.1.6.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 17.	H.1-2.	I.4.	L.3.9.12.	K.2.4.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 18.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 19.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.3.
No. 20.	H.1-2.	I.2.	L.4.9.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 21.	H.1.	I.3.	L.3-4. 8-9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.2.	G.2.3.
No. 22.	H.1-2.	I.1.	L.4.9.12.	K.1.4.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 23.	H.1.	I.2.	L.4.9.12.	K.1.5.	C.1.3.5.8.10.11.13.	A.1.3.	G.2.4.
No. 24.	H.1-2.	I.1.	L.4.9.12.	K.3.4.	C.2.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 25.	H.1-2.	I.4.	L.4.9.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.
No. 26.	H.1-2.	I.2.	L.3.9.12.	K.1.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 27.	H.1.	I.4.	L.3.8.12.	K.1.6.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 28.	H.1-2.	I.4.	L.4.9.12.	K.2.5.	C.2.4.5.8.9.12.13.	A.2.	G.1.3.
No. 29.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.11.13.	A.1.3.	G.1.
No. 30.	H.1-2.	I.3.	L.4.9.12.	K.1.4.	C.1.3.5.8.10.11.13.	A.1.3.	G.1.
No. 31.	H.1-2.	I.4.	L.4.9.13.	K.2.6.	C.1.4.5.8.10.12.13.	A.1.4.	G.2.4.

No. 32.	H.1.	I.2.	L.4.9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 33.	H.1-2.	I.3.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.
No. 34.	H.1-2.	I.4.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.3.
No. 35.	H.1-2.	I.4.	L.3.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 36.	H.1.	I.4.	L.4.9.12.	K.1.4.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 37.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 38.	H.1-2.	I.4.	L.3.9.12.	K.1.4.	C.1.3.5.8.10.11.13.	A.1.3.	G.1.4.
No. 39.	H.1-2.	I.3.	L.4.8.12.	K.3.5.	C.2.3.5.8.10.12.14.	A.2.	G.1.4.
No. 40.	H.1-2.	I.4.	L.3.8.13.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.4.	G.2.3.
No. 41.	H.1-2.	I.2.	L.4.9.12.	K.3.5.	C.2.4.5.8.10.11.13.	A.1.3.	G.1.4.
No. 42.	H.1-2.	I.1.	L.4.9.11.	K.1.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.3.
No. 44.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 46.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.11.13.	A.1.3.	G.1.
No. 72.	H.1.	I.4.	L.4.9.12.	K.1.5.	C.1.3.5.8.9.12.13.	A.1.3.	G.2.
No. 76.	H.1-2.	I.4.	L.4.9.12.	K.1.5.	C.1.3.5.8.10.11.13.	A.1.3.	G.2.4.
No. 81.	H.1-2.	I.4.	L.4.9.11.	K.1.5.	C.1.4.8.10.12.13.	A.1.3.	G.1.4.
No. 88.	H.1-2.	I.2.	L.3.8.12.	K.2.4.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 89.	H.1.	I.3.	L.3.8.12.	K.1.6.	C.2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 107.	H.1-2.	I.1.	L.4.8.12.	K.1.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.4.

The great intra-specific heterozygosity of this population is evident from the above analysis. Attention should be called to the following :—

1. The predominance of the strict habit. All the plants analyzed above show it to a greater or less degree.
2. All our four grades of indumentum are recorded.
3. The leaves do not show a great range in length or breadth.
4. Two plants showed much anthocyanin, two none, and the remainder an intermediate amount.
5. All three grades of calyx shape occurred.
6. Eight plants had much anthocyanin in the calyx, four had no anthocyanin, and the remainder some anthocyanin.
7. Long, short, broad, and narrow petal characters occurred in all four possible combinations.
8. All the petals were bilobed.
9. None of the petals overlapped but in three plants the lobes overlapped.
10. Eleven plants had anthocyanin blotches on the petals.
11. One individual showed two-thirds lobing of the petals, the remainder three-quarters.
12. Ten plants were functionally female, the hermaphrodite plants (40) had mostly pink filaments, only five plants having white ones.
13. Coloured and colourless styles and immature seeds occurred in all four possible combinations.
14. All flowers had mere bosses, except in No. 88, where distinct scales were present.

Potterne Field (2 miles S. of Devizes), Wilts., 4.7.27.

This is a large field of arable land subject to rotation which includes clover. The soil is a stiff calcareous clay derived from an outlier of Lower Chalk (grey marly chalk) which is here 50 to 80

feet thick on the top of the Upper Greensand. The weed flora is usually fairly rich and includes *Centaurea Scabiosa* L., *Ranunculus arvensis* L., *R. repens* L., *Scabiosa arvensis* L., *Bartsia Odontites* Huds., *Daucus Carota* L., *Lithospermum arvense* L., *Ornithogalum pyrenaicum* L., *Lychnis Githago* Scop., *Viola arvensis* Murr. (s.l.), *Medicago sativa* L. (relict of cultivation), *Myosotis arvensis* Hill, and *Alopecurus myosuroides* Huds.

The *Silene* plants are fairly abundant and well distributed on the southern slope of the ridge. They here do best when the land is under corn, persisting as poor specimens when it is under temporary ley. It is very remarkable how the thick roots of even old plants can withstand the frequent ploughing and breaking to which they are subjected. Quite small pieces produce adventitious buds and re-establish the plant with branches and flowers of good tone. The removal of plants for breeding purposes has indicated that practically all plants in this field have damaged rootstocks. Exactly the same conditions occurred in arable fields near Barton Stacey, Hants.

This population is very different from that described above from the same county. While the difference in habitats is a possible cause, the action may be by direct modification or by selection. On the other hand the possibility of mutations or of temporal or spatial limitations to actual distribution cannot be ignored. The Potterne Field plants are more robust than those of All Cannings Down, with stouter stems and larger leaves, and on the whole they are more floriferous. No plants of strict habit have so far been found and very few show even a verging towards it. Plants scorable into every one of our four indumentum classes have been collected, from densely pubescent to glabrous. The population shows less development of anthocyanin than that at All Cannings, although fewer plants have been found totally devoid of anthocyanin. The inflorescences show a remarkable range in size and degree of compactness. This often fluctuates even from season to season in the same individual. One plant was collected with very long peduncles—26 cm. from the highest pair of leaves to the first flowers. The calyces of most plants are of the inflated type. Anthocyanin blotch on the petals nas been recorded once in this population. Female plants occur, and as usual have smaller flowers than hermaphrodites. The same range in colour of filaments, stigmata, and immature seeds occurs as at All Cannings. A sample of 45 plants collected in the fruiting condition from this population was scored as follows :—

Mature seeds : 2 armadillo, 14 weak armadillo, 27 tubercled, 2 strongly tubercled.

Capsules : 18 type I, 10 type II, 17 intermediate.

Barton Stacey, Hants, 10.7.29.

The population studied extended over a number of fallow, and neglected, arable fields. The period during which the fields had been fallow varied from one to five or six years. The weed-flora

was abundant in all—*Cirsium arvense* Scop. being the most widespread species. The soil was sandy and gravelly in nature. In the most recently ploughed fields the thick roots and root-stocks had been much broken and practically no entire plants, apart from seedlings, could be found. In the absence of close competition this ploughing up of the plants in no way injures their reproductive power and appears even to increase their vegetative vigour or at least to improve their tone.

No. 1.	H.2.	I.2.	L.2-3.8.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.1.4.	G.2.3.
No. 2.	H.2.	I.4.	L.3.8-9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 3.	H.2.	I.3.	L.4.8-9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 4.	H.2.	I.1.	L.3.8.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 5.	H.1.	I.4.	L.4.9.12.	K.1.5.	C.2.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 6.	H.1.	I.4.	L.4.9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.1.4.	G.2.
No. 7.	H.1.	I.2.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 8.	H.1-2.	I.4.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 9.	H.1.	I.4.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 10.	H.2.	I.1.	L.4.8.12.	K.1.5.	C.2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 11.	H.1-2.	I.2.	L.4.9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.2.3.
No. 12.	H.1.	I.4.	L.4.9.12.	K.1.5.	C.2.4.5.8.10.12.13.	A.1.3.	G.2.3.
No. 13.	H.1.	I.2.	L.3.9.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 14.	H.1.	I.4.	L.3-4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 15.	H.1.	I.3.	L.4.8-9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.3.
No. 16.	H.1.	I.1.	L.3-4.9.12.	K.2.5.	C.2.3.5.8.10.12.13.	A.1-2.4.	G.2.4.
No. 17.	H.1.	I.3.	L.3-4.9.12.	K.1.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 18.	H.1.	I.3.	L.4.8-9.12.	K.2.5.	C.2.3.5.8.10.12.13.	A.1.3.	G.1.4.
No. 19.	H.1.	I.4.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.

Hog's Back, Guildford, 2.7.28.

The relatively small population analyzed for vegetative and floral characters was collected on a tall hedge-bank on the top ridge. The plants were scattered along about 200 yards. The soil was derived directly from the Chalk.

No. 1.	H.2.	I.4.	L.4.8-9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.3.
No. 2.	H.1.	I.1.	L.4.9.12.	K.3.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.4.
No. 3.	H.2.	I.1-2.	L.3.8.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.2.4.
No. 4.	H.2.	I.2.	L.3.8.12.	K.3.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.
No. 5.	H.2.	I.3.	L.3.8.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.2.	G.1.3.
No. 6.	H.2.	I.1.	L.4.9.12.	K.3.5.	C.1.3.5.8.10.12.	A.1.3.	G.1.3.
No. 7.	H.1-2.	I.4.	L.3-4.8.12.	K.1.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 8.	H.2.	I.1.	L.3.8.12.	K.1.	C.1.3.5.8.10.12.	A.1.3.	G.1.4.
No. 9.	H.2.	I.4.	L.3-4. 8-9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.1.3.
No. 10.	H.2.	I.2.	L.4.8.12.	K.1.5.	C.2.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 11.	H.2.	I.2.	L.4.8-9.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.3.
No. 12.	H.2.	1.2-3.	L.4.9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 13.	H.2.	I.2.	L.4.9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.1.3.	G.2.3.
No. 14.	H.2.	I.3.	L.3-4. 8-9.12.	K.2.5.	C.1.3.5.8.9.12.13.	A.1.3.	G.2.4.

In addition to the population analyzed for vegetative and floral characters three populations were sampled for fruits and seeds. The field details are :—

I. Nos. 1-50. On the slopes of the Hog's Back near Guildford. 50 samples were collected from as many plants of the thousands growing in an arable field left fallow. The area from which the 50 items were collected was 50 yards long and 7 yards wide. Within this area there were several hundreds of plants. The remainder of the field was not sampled.

II. Nos. 51-75. From a hedge bank near the highest point of the Hog's Back. 25 samples from as many plants out of a population of about 100. This was the bank from which the flowering specimens had been collected earlier in the year.

III. Nos. 76-100. From various fields and roadsides on the top of the Hog's Back.

The analyses gave the following totals :—

Nos. 1-50.
- Capsules type I 17.
- Capsules type II 13.
- Capsules intermediate 20.
- Seeds armadillo 4.
- Seeds weak armadillo 5.
- Seeds tubercled 34.
- Seeds strongly tubercled 7.

Nos. 51-75.
- Capsules type I 7.
- Capsules type II 12.
- Capsules intermediate 6.
- Seeds armadillo 1.
- Seeds weak armadillo 2.
- Seeds tubercled 19.
- Seeds strongly tubercled 3.

Nos. 76-100.
- Capsules type I 5.
- Capsules type II 10.
- Capsules intermediate 10.
- Seeds armadillo 2.
- Seeds weak armadillo 3.
- Seeds tubercled 18.
- Seeds strongly tubercled 2.

Totals for the 100 items.
- Capsules type I 29.
- Capsules type II 35.
- Capsules intermediate 36.
- Seeds armadillo 7.
- Seeds weak armadillo 10.
- Seeds tubercled 71.
- Seeds strongly tubercled 12.

N.E. of Romney Street, Shoreham District, Kent, 19.6.28.

The interesting population, a sample of which is analyzed below, was growing on waste grassy land reserved as a building plot. *Silene vulgaris* was the dominant species on the plot.

No. 1.	H.2.	I.2.	L.2.7.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 2.	H.2.	I.2.	L.3.8.12.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	
No. 3.	H.2.	I.4.	L.3-4.8.12.	K.2.5.	C 2.4.5.8.10.12.13.	A.2.	G.2.4.
No. 4.	H.2.	I.2.	L.3.7.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.2.4.
No 5.	H.2.	I.1.	L.4.8.12.	K.2.5.	G.1.3.5.8.9.12.13.	A.1.3.	G.1.4.
No. 6.	H.1.	I.1.	L.4.9.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.1 4.
No. 7.	H.1.	I.4.	L.3.8.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.1.4.
No. 8.	H.2.	I.3.	L.4.8.11.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.3.
No. 9.	H.2.	I.4.	L.4.8.12.	K.2.5.	C.1.3.5.8.9.12.13.	A.1.3.	G.1.4.
No. 10.	H.2.	I.1.	L.3-4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.4.
No. 11.	H.1-2.	I.3.	L.4.8-9.12.	K.3.5.	C.2.4.5.8.9.12.13.	A.2.	G.2.
No. 12.	H.1-2.	I.4.	L.4.9.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.4.
No. 13.	H.1.	I.2.	L.4.9.12.	K.3.5.	C.1.4.5.8.10.12.13.	A.2.	G.1.4.
No. 14.	H.2.	I.4.	L.3.8.12.	K.2.5.	C.1.4.5.8.10.12.13.	A.2.	G.1.
No. 15.	H.1.	I.2.	L.4.9.12.	K.2.5-6.	C.1.3.5.8.9.12.14.	A.1.3.	G.1.4.
No. 16.	H.1.	I.4.	L.3-4. 8-9.12.	K.1.5.	C.1.3.5.8.9.12.13.	A.1.3.	G.1.

Bradfield, Berks, 9.7.29.

Two populations were examined. The first (examples Nos. 1 to 9) occurred on a rough piece of ground on the top of a rabbit warren in a hay-field, and the patch is usually avoided by the mowers. The sub-soil is gravel and the soil very shallow. The second population (examples 10 to 14) occurred on and around a disused gravel pit about 1½ miles from the hay-field. The second population was a small one.

In addition to the analyses in the following table different samples were scored for certain characters as follows :—

1. *Indumentum* : 100 plants. 20 hairy, 80 glabrous (the degree of pubescence not being scored).
2. *Colour of immature seeds* : 40 plants. 8 purplish, 32 white.
3. *Mature fruits and seeds.* Armadillo 4, weak armadillo 5, tubercled 44, strongly tubercled 5.
4. *Mature seeds* (another sample). Armadillo 5, weak armadillo 4, tubercled 52, strongly tubercled 5.

No. 1.	H.2.	I.3.	L.3.8.12.	K.1.5.	L.1.3.5.8.10.12.13.	A.1.4.	G.2.4.
No. 2.	H.2.	I.2-3.	L.3.8.12.	K.3.5.	L.1.4.5.8.10.12.13.	A.1.3.	G.1.3.
No. 3.	H.2.	I.1.	L.3-4.8.12.	K.1.5.	L.2.4.5.8.10.12.13.	A.1-2.3.	G.1.4.
No. 4.	H.2.	I.3.	L.3.8.12.	K.2.5.	L.1.3.5.8.10.12.13.	A.1.3.	G.1.3.
No. 5.	H.2.	I.1.	L.3.8.12.	K.1.5.	L.1.3.5.8.10.12.13.	A.1.3.	G.2.4.
No. 6.	H.1-2.	I.4.	L 3.8.12.	K.3.5.	L.2.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 7.	H.1-2.	I.4.	L.3.8.12.	K.1.5.	L.2.4.5.8.9.12.13.	A.1.3.	G.2.3.
No. 8.	H.1.	I.2-3.	L.4.9.12.	K.3.5.	L.1.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 9.	H.1-2.	I.4.	L.3.8.12.	K.2.5.	L.2.4.5.8.10.12.13.	A.1.3.	G.2.4.
No. 10.	H.1.	I.4.	L.2-3. 8-9.12.	K.3.4.	L.1.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 11.	H.1.	I.4.	L.2.8.12.	K.2.5.	L.1.4.5.8.10.12.13.	A.1.4.	G.2.4.
No. 12.	H.1-2.	I.1-2.	L.3.8.12.	K.2.5.	L.2.4.5.8.10.12.13.	A.1.3.	G.1.4.
No. 13.	H.2.	I.4.	L.3.8.12.	K.2.5.	L.2.4.5.8.10.12.13.	A.2.	G.1.3.
No. 14.	H.2.	I.4.	L.3.8.12.	K.1.5.	L.2.4.5.8.10.12.13.	A.1.3.	G.1.4.

Windsor (Berks).

A population growing on alluvial soil amongst luxuriant grasses, on the sides of the towing path of the bank of the Thames near Old

Windsor, was examined on June 25, 1927. The population was much smaller than most of those recorded above, but showed a remarkable diversity in habit and leaf characters as follows :—

No. 1. Of not strict habit, stems up to 8 dm. long ; leaves averaging 4 cm. long and 1 cm. broad, but up to 6·5 cm. long by 2·4 cm. broad.

No. 2. Verging towards a strict habit ; stems up to 7 dm. long ; leaves averaging 4 cm. long and 1·2 cm. broad, but up to 5·6 cm. long by 1·8 cm. broad.

No. 3. Of not strict habit ; stems up to 7·5 dm. long ; leaves averaging 4·5 cm. long and 1·2 cm. broad, but up to 6·3 cm. long by 1·5 cm. broad.

No. 4. Of not strict habit ; stems up to 9 dm. long ; leaves averaging 5·7 cm. long and 2·1 cm. broad, but up to 7·7 cm. long by 3·7 cm. broad. Noteworthy because of its broad ovate leaves.

No. 5. Of not strict habit ; stems up to 5 dm. long ; leaves averaging 3 cm. long and 8 mm. broad, but up to 4·3 cm. long and 1 cm. broad. Noteworthy for its markedly lanceolate leaves.

No. 6. Of definitely strict habit ; stems up to 4 dm. long ; leaves averaging 2·5 cm. long and 6 mm. broad, but up to 4·3 cm. long by 11 mm. broad.

No. 7. Of not strict habit ; stems up to 8 dm. long ; leaves averaging 6·3 cm. long and 1 cm. broad, but up to 8·6 cm. long by 1·3 cm. broad. This plant is unique in our experience by its long parallel-sided (linear) leaves.

The whole population was glabrous.

Chipperfield (Herts.).

A series of five plants from the Chipperfield district of Hertfordshire was collected on June 10, 1928, in young flower. The specimens do not represent a sample of a unit population but are of interest because of the occurrence of a strict plant (No. 4) and of a hairy plant (No. 5). Nos. 1, 2, and 3 were from shady habitats and show the effects of shade in their weak, elongated stems and flaccid leaves.

No. 1.	H.2.	I 4.	L.3.8.13.	K.1.5.	C.1.4.5.8.10.12.13.	A.2.	G.1.
No. 2.	H.2.	I.4.	L.3.8.13.	K.2.5.	C.1.3.5.8.10.12.13.	A.2.	G.1.
No. 3.	H.2.	I.4.	L.2-3.8.13.	K.2.5.	C.1.3.5.8.10.12.13.	A.1.3.	G.1.
No. 4.	H.1.	I.4.	L.3-4.8.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.
No. 5.	H.1-2.	I.2.	L.4.8.12.	K.2.5.	C.2.4.5.8.10.12.13.	A.2.	G.1.

Summary and Conclusions.

1. Descriptions are given of stock-plants of *Silene vulgaris*, which have been used up to 1930 for breeding experiments. These descriptions alone indicate that a great range of characters and character-combinations occurs in nature.

2. The characters which have been found in the species as a whole, excluding mountain plants, are considered under the following headings :—roots, stems, indumentum, leaves (general, shape, size, margin, texture, and colour), inflorescence, flowers, calyx, corolla

(petal length, petal breadth, petal lobing, anthocyanin blotch), androecium (sex), gynaeceum (stigmata colour, colour of immature seeds), fruits (carpophore, teeth, loculi), mature seeds (testa pattern, number of seeds per capsule).

3. It is shown that there are many different characters exhibited by the various organs within the one species. Moreover these occur in numerous combinations, and, at present, we have no reason for supposing that any theoretically possible combination does not occur in nature.

4. As for *S. maritima* so for *S. vulgaris* a scheme involving the use of letter and figure symbols has been prepared, and used with considerable advantages, for scoring character-combinations in wild populations.

5. An account of wild populations growing near All Cannings Farm (Wilts), Potterne (Wilts), Barton Stacey (Hants), Guildford (Surrey), Shoreham (Kent), Bradfield (Berks), Windsor (Berks), and Chipperfield (Herts) is given.

XX.—THE CASUARINA DISTYLA COMPLEX.

E. D. Macklin.

Historical.

For the past fifty years there has been a great deal of confusion among the shrubby species of the genus *Casuarina* occurring in Australia. Recently* it was found that there were seven species, widely distributed through the Continent, grouped under the name of *C. distyla* Vent.

The origin of this confusion can be traced to the later work of Miquel, whose earlier valuable revision of the Casuarinas† was the first authentic account of the then known species. Before the publication of this revision Miquel had examined the specimens contained in Sir William Hooker's vast collection and all the plants growing at that time in the Berlin Gardens. In this work he described, in most cases minutely, and illustrated some thirty species, including *C. Baxteriana*. It is noteworthy that he recognised in Gunn's No. 735 from Tasmania two species, one of which he considered *C. distyla* Vent. and the other he described and named *C. rigida*. Unfortunately his *C. rigida* is synonymous with the *C. distyla* of Ventenat, whilst his *C. distyla* is a new species, *C. paradoxa* E. D. Macklin (q.v. p. 150). In 1859 he described *C. Muelleriana* which had been collected by Mueller in the Mount Lofty Ranges (S. Australia) in 1850. Later‡ he placed *C. Muelleriana* and *C. Baxteriana* as varieties of *C. suberosa* Otto et Dietr. with which they show close affinity. Mueller, Bentham and other botanists of that time, however, regarded them both as being *C. distyla* Vent. In

* Macklin, E. D., "A Revision of the 'Distyla Complex' of the Genus *Casuarina*." Trans. Roy. Soc. S. Australia, li. 257–286 (1927).

† Revisio Critica Casuarinarum, Verh. Akad. Amst. l. xiii (1848).

‡ Flora No. 2, January 1865, p. 24; DC. Prodr. xvi. pt. 2 (1864-1868).

1865, with more specimens available, Miquel again changed his views. He grouped his *C. rigida* and *C. Fraseriana*, forms previously considered by him to be distinct, under the name of *C. distyla* Vent. However he also became firmly convinced that the *C. stricta* of Aiton (1789) was synonymous with *C. distyla* Vent. (1803). This error was corrected by Bentham in 1873* and has been recently verified by the writer.

In 1868 Mueller† published a description of *C. distyla* Vent., under the name of *C. stricta* Ait., widened to embrace all the closely related forms that he had collected but apparently never distinguished. Bentham adopted Mueller's wider definition, regarding *C. rigida* Miq., *C. Baxteriana* Miq. and *C. Muelleriana* Miq. as synonoms of *C. distyla* Vent., but unlike Mueller he retained the latter name. It is to these all-embracing descriptions that one can trace the confusion existing in the Commonwealth to-day in the "*Distyla complex*," for each State claims to have *C. distyla* Vent., and in most of them a different species is represented.

Specific Characteristics.

There are certain reliable characteristics which are constant throughout any given species. The following are the most important vegetative features: the angularity of the ridges, the size and nature of the sheathing teeth in each whorl, and the length of the internodes. As regards the cones of the species dealt with in this paper, only the presence or absence of the dorsal protuberance of the valves and the degree of protrusion of the latter are worth consideration.

The greatest assistance to taxonomic work in the Casuarinas is to be gleaned from the male inflorescence. The average length of the male spike and the colour of the anthers are useful, while the arrangement of the sheaths on the axis, whether they are overlapping, merely touching, or moniliform, is a relatively constant feature. The condition of the male flower when mature has been found to be a very valuable aid to taxonomic work in the genus. The bracteoles may be retained in the open flower as in *C. lepidophloia* F. Muell. (recently found by the writer to be synonymous with the previously named *C. cristata* of Miquel), *C. distyla* Vent. (*C. rigida* Miq.), *C. paludosa* var. *robusta* Macklin, *C. paradoxa* Macklin n. sp., vide p. 150), *C. Muelleriana* Miq. and *C. Baxteriana* Miq. In fewer cases they are shed, leaving the mature flower consisting of one stamen and its sheathing bract, e.g. *C. stricta*, *C. Luehmanni* and *C. striata*. In *C. stricta* the two bracteoles are woody and cohere along the upper abaxial margin by means of branching hairs. The relative size of the persistent bracteoles to the sheathing-teeth also appears to be constant and can therefore rank among the more specific characteristics in the genus.

* Flora Austral. vi. 192–202.

† Frag. Phytog. Austr. vi. 19 (1867–1868).

The anatomical structure of the branchlets has been found to give valuable help in some cases to taxonomic work in the genus. A full account of the anatomy of the South Australian species has recently been published by the writer* and details of the anatomy may be found there. The feature that has been found most useful in the diagnosis of species is the distribution of lignification in the ridges and above the cauline bundles. The various types which occur are illustrated in the diagrams on p. 281 of the work cited above.

Key to the Species of the " Distyla Complex."

Characters of the group : -Branchlets simple, ascending ; sheathing teeth 5–9 ; cone valves scarcely prominent ; valves with a conspicuous dorsal protuberance.

Bracteoles of male flowers deciduous ; internodes 1–2 cm. long ; male spikes 2–3 cm. long, cylindrical ; anthers golden brown ; tall spiky shrub ; southern species.....*C. striata* 1.

Bracteoles of male flowers persistent :

Internodes usually 1 to 1·8 cm. long ; branchlets robust ; male spikes up to 8 cm., robust, moniliform ; anthers yellow ; tall shrub with angular branchlets ; eastern species....*C. distyla* 2.

Internodes 1 cm. or under ; branchlets less robust ; male spikes less than 6 cm. in length :

Branchlets terete ; cones under 2 cm. long ; male spikes not moniliform ; small shrubs :

Sheathing teeth 6–8, narrow-lanceolate, long ; bracteoles of male flowers not exserted :

Slender shrub ; male spikes about 2 cm. long, almost imbricate ; branchlets heptagonal-terete ; grooves frequently hairy ; teeth not ciliolate ; eastern species... *C. paludosa* 3.

More robust, spiky shrub ; male spikes up to 6 cm. long, robust ; branchlets cylindrical ; grooves not hairy ; teeth ciliolate ; southern species..... *C. paludosa* var. *robusta* 3a.

Sheathing teeth 5–7, ovate-lanceolate, short ; bracteoles of male flowers exserted ; male spikes 2–3 cm. long, slender ; anthers rust-coloured ; low cushion-like shrub; southern species.....*C. pusilla* 4.

Branchlets angular ; cones larger ; male spikes moniliform ; taller shrubs :

Sheathing teeth 6–8, usually 7, ovate-lanceolate, overlapping, slightly recurved, brown and scarious at the tips ; branchlets slender ; male spikes 2–3 cm. long ; bracteoles of male flowers scarcely exserted ; anthers reddish-brown ; cones narrow-cylindrical ; eastern species.....*C. paradoxa* 5.

*Macklin, l.c. 277–284.

Sheathing teeth triangular, adpressed, convex on back, pale straw-coloured or vermilion tipped; branchlets more robust; male spikes more remote:

Sheathing teeth 5–8, usually 7; male spikes 2–3 cm. long; bracteoles exserted; anthers golden-brown; cones narrow-cylindrical, finely featured; seeds small; western species.....*C. Baxteriana* 6.

Sheathing teeth 5–7, usually 6; male spikes up to 5·5 cm. long; bracteoles more exserted; anthers red; cones more globular, large, coarsely featured; seeds large; southern and south-eastern species...*C. Muelleriana* 7.

Enumeration of Species.

1. **Casuarina striata** *Macklin* in Trans. Roy. Soc. S. Austral. li. 267 (1927).

South Australia. Mount Lofty Ranges: Belair, *E. D. Macklin* 035 (♂) and 036 (♀) (type in Tate Herb., Adelaide, co-types in Kew, Sydney, Melbourne, and Brisbane Herbaria); Blackwood, 1913, *T. G. B. Osborn* 053 (Tate Herb.); Aldgate, 1907, *J. H. Maiden* (Herb. Kew.); Echunga, *E. D. Macklin* 054 (Tate Herb.); Happy Valley and between Clarendon and McLaren Vale, *J. B. Cleland* (Herb. Cleland); Sturt Creek (1849) and Port Adelaide, *Blandowski* (Natl. Herb. Victoria); Mount Compass, *E. D. Macklin* 057 (Tate Herb.); Myponga, *J. B. Cleland* 043 (Tate Herb.); Encounter Bay, *E. D. Macklin* 058 (Tate Herb.); Ashbourne, *J. B. Cleland* (Herb. Cleland). Kangaroo Island, Dudley Peninsula, 1883 (Tate Herb.). *Flowering Season*: June to December.

A very variable shrub, dioecious or monoecious, usually fastigiate and spiky, sometimes divaricate. Frequently it assumes the form of a small tree.

2. **Casuarina distyla** *Ventenat* in Jard. Cels. t. 62 (1803).—*C. rigida* Miq. Rev. Cas. 61, t. vii D (1848); et in DC. Prodr. xvi. sect. 2. 337 (1868); Macklin in Trans. Roy. Soc. S. Austral. li. 269 (1927).

Tasmania. 1803, *Ventenat*, type! (Herb. Geneva); Georgetown, 1842, *Gunn* 735 (syntype of *C. rigida* Miq.); Lake St. Clair, 1845, *Gunn* 735 (Herb. Kew.); Hobart, 1840, *Gunn* 735 (Herb. Mus. Brit.); Hobart, *Hooker* (Herb. Kew.); Hobart, 1819, *A. Cunningham* 90 (Herb. Kew.); Browne's R., *Oldfield* (Herb. Kew.); St. Paul's R., *Archer* (Herb. Kew.); Cradle Mts., 1925 (♂ & ♀) *G. Weindorfer* (Herb. Kew.); Flinders' Isd., Grass Tree Plain, 1844, *J. Milligan* (Herb. Mus. Brit.); Flinders' Isd., 1912, *J. B. Cleland* (Herb. Adel.). Queensland. Moreton Bay, *Fraser* (syntype of *C. rigida* Miq.) (Herb. Kew.). New South Wales. Pt. Jackson, *R. Brown* 3130 (Herb. Kew. & Herb. Mus. Brit.), *Mueller* (Herb. Kew.), and 1897 (♀) (Herb. Adel.); Sydney, *J. D. Hooker* (Herb. Kew.), 1822, *Sieber* 326 (Herb. Kew.), 1835, *J. Backhouse* 317 (Herb. Mus. Brit.), *Stephenson* 371 (♀) (Herb. Kew.), 1909, *J. B. Cleland* (Herb. Adel.); Sydney Heads, 1862,

R. T. Lowne (Herb. Kew.) ; Botany Bay, *Sinclair* 780 (Herb. Kew.), 1799-1810, *C. Caley* (Herb. Mus. Brit.), *J. D. Hooker* (Herb. Kew.), 1906, *L. Boorman* (Natl. Herb. N.S.W.) ; Bondi Bay, 1912, *J. E. Tilden* 558 (Herb. Kew. & Herb. Mus. Brit.) ; Jervis Bay, (Natl. Herb. N.S.W.) ; Bowen Isd. (Jervis Bay), 1925 (♀), *F. A. Rodway* (Herb. Kew.) ; Castlereagh R., 1883, *I. Lamont* 22 (Herb. Mus. Brit.) ; Blue Mts., Katoomba, 1914, *A. B. Rendle* (Herb. Mus. Brit.) ; Echo Pt., *E. D. Macklin* 045 (Herb. Kew. & Herb. Adel.) ; 1770, *Banks and Solander* (Herb. Mus. Brit.) ; 1840, *Armstrong* (Herb. Mus. Brit.) ; *Sieber* 330 (Herb. Mus. Brit.). WESTERN AUSTRALIA. Swan R., *Drummond* (Herb. Kew.), ♀ cones only, thus scarcely constituting an authentic record. NO LOCALITY, *R. Brown* 3134 (Herb. Kew.).

3. **Casuarina paludosa** *Sieb.* in Spreng. Syst. iii. 803 (1826) ; Miq. Rev. Cas. 64, t. 8 B (1848) ; Miq. in DC. Prodr. xvi. sect. 2. 338 (1868).—*C. pumila* Otto et Dietr. in Allg. Gartenz. 1841, 163 ; Miq. Rev. Cas. 66, t. 8 C (1848). *C. dumosa* A. Cunn. Herb. *C. distyla*, var. *paludosa* Benth. Fl. Austral. vi. 199 (1873).

NEW SOUTH WALES. Port Jackson to the Blue Mountains, *Sieber* 329 ; Twofold Bay, *A. Cunningham* (both in Herb. Kew.).

3a. Var. **robusta** *Macklin* in Trans. Roy. Soc. S. Austral. li. 271 (1927).

SOUTH AUSTRALIA. Upper Hindmarsh Valley, *E. D. Macklin* 013 (♂) and 014 (♀) (type specimens in Tate Herb. Adelaide, co-types in Kew, Sydney, Melbourne and Brisbane Herbaria) ; Mount Compass, *E. D. Macklin* 006 (Herb. Adel.) ; Kuitpo, *M. R. Jacobs* 008 (Herb. Adel.) ; Myponga, *J. B. Cleland* (Herb. Cleland) ; Keith, *J. M. Black* (Herb. Black) ; Wirrega, *T. G. B. Osborn* 050 (Herb. Adel.) ; Furner, *T. B. Paltridge* 010 (Herb. Adel.).

Usually occurring on stiff clay soils with little or no depth of sand.

Flowering Season :—January to August.

4. **Casuarina pusilla** *Macklin* in Trans. Roy. Soc. S. Austral. li. 272 (1927).

SOUTH AUSTRALIA. Encounter Bay, *E. D. Macklin* 021 (♂) and 020 (♀) (type specimens in Tate Herb. Adelaide, co-types in Kew, Sydney, Melbourne and Brisbane Herbaria) ; Macclesfield to Strathablyn, *J. M. Black* (Herb. Black) ; Port Elliot, *J. B. Cleland* 015 (Herb. Adel.) ; Nuriootpa, *Tepper* (Herb. Tepper) ; Wirrega, 1916, *T. G. B. Osborn* 051 (Herb. Adel.) ; Keith, South of Lamaroo and Paringa, *J. M. Black* (Herb. Black) ; South East, *F. J. Paltridge* 017 (Herb. Adel.) ; Monarto South, *J. B. Cleland* (Herb. Cleland). VICTORIA. N.W. Desert, *Lorton* (Nat. Herb. Vict.) ; Pt. Lonsdale, 1912, *J. Tilden* (Herb. Mus. Brit.).

Flowering Season :—Not definitely known ; flowers have been collected in January and from May to August.

5. **Casuarina paradoxa** *Macklin*, n. sp.—*C. distyla* Miq. Rev. Cas. 57, t. vii A-C (1848); Macklin in Trans. Roy. Soc. S. Austral. li. 274 (1927); non Vent.

As the type specimen of *C. distyla* Vent. was not available in Australia at the time the previous work* was done full reliance had necessarily to be placed on Miquel's description for the determination of that species. Since then the writer has examined the type of *C. distyla* Vent. and finds that *C. rigida* Miq. is synonymous with it. The species described in the previous paper under the name of *C. distyla* Vent. (also that described by Miquel on p. 57 of his revision) is a new species of which a latin description and full records will shortly be published, probably in the Transactions of the Royal Society of South Australia.

6. **Casuarina Baxteriana** *Miquel*, Rev. Cas. 37, t. iii C (1848).—*C. suberosa* Otto et Dietr., var. *Baxteriana* Miq. in DC. Prodr. xvi. sect. 2. 338 (1868). As *C. Baxteriana* was not included in the previous paper a description is here given.

A slender upright *shrub*, monoecious or dioecious. *Branches* reddish-brown, striate with adnate leaves; branchlets simple, erect, dense, strict, whorled and frequently unilaterally placed, fairly robust, but more slender in male plants, distinctly angular, usually short but may reach 13 cm. in length; internodes 3–7 mm., usually under 5 mm. long, about 1 mm. in diam. *Sheathing teeth* 5 to 8, usually 7, long, narrow-triangular, adpressed, margins hyaline, ciliate when young but merely lacerate in mature teeth, convex on the back; sheaths and teeth pale straw-coloured; teeth of branches longer and sometimes recurved, truncate in age. *Male spikes* up to 3 cm. in length, sheaths remote, leaving small portions of the axis bare; bracteoles persistent, as long as or slightly longer than the sheathing teeth; anthers golden-brown. *Cones* borne in whorls or singly upon the old wood, subsessile or on a peduncle of 0·5 cm. in length; cones up to 3 cm. long, frequently shorter, 1 to 1·5 cm. in diam., narrowly cylindrical, usually obtuse, but sometimes conical or beaked and partly sterile; valves broadly elliptical, scarcely prominent, dorsal protuberance present, bluntly pyramidal; bracts large, broadly ovate-acuminate, light in colour. Cones when well formed are very regular and finely featured; seeds very small and dark coloured.

Western Australia. King George's Sound, 1892-3, *Veitch* (Herb. Kew.); Claremont, Lower Swan R., *A. Morrison* (Herb. Kew.); Between Perth and King George's Sound, 1854 (♂ & ♀), *W. H. Harvey* (Herb. Kew.); Hills near Albany, 1902 (♀), *C. Andrews* 862 (Herb. Mus. Brit.); Westbourne, Dwalganup (♀), 1915, *C. B. Carter* 32 a (Herb. Kew.); S. W. Plantagenet, 1901, *Pritzel* 238 (♀) & 239 (♂) (Herb. Kew.); Kalgan R. (♀), *Oldfield* 137 (Herb. Kew.); Pemberton, *F. J. Paltridge* 060 & 064 (monoecious) (Herb. Adel.); 1845, *Drummond* 232 (♂) (Herb. Kew.).

* Loc. cit.

Flowering Season :—unknown.

C. Baxteriana Miq. (1848) has for many years been known as *C. distyla* Vent. However, apart from differences in the sheathing teeth, male spikes and anatomical structure these two species are widely separable geographically, *C. distyla* being, so far as is known at the present time, an eastern species and *C. Baxteriana* confined to the West, *neither occurring in the intervening state, South Australia.* More closely related to *C. Baxteriana* is *C. Muelleriana*, which occurs in South Australia and in the west of Victoria. These are also readily distinguished morphologically and indeed the anatomy of each is sufficiently distinct to warrant them being recognised as definite species.

7. **Casuarina Muelleriana** *Miq.* in Ned. Kruidk. Arch. iv. 99 (1856).—*C. suberosa* Otto et Dietr., var. *Muelleriana* Miq. in DC. Prodr. xvi. sect. 2. 338 (1868).

South Australia. Mount Lofty Range, 1850, *Mueller* (Natl. Herb. Vict.) ; Hills above Magill, 1885 (Herb. Kew.) ; Belair, 1902, *Koch* 866 (Herb. Kew.), *E. D. Macklin* 032 (♀ and ♂) (Herb. Kew. & Herb. Adel.) ; between Aldgate and Mylor, *E. D. Macklin* 027 (♀) (Herb. Adel.) ; Mount Torrens, *E. D. Macklin* 024 (♂) (Herb. Macklin) (type locality) ; between Hallett's Cove and Noarlunga, Mount Compass to Encounter Bay, Ashbourne, Coonalpyn, all *J. B. Cleland* (Herb. Cleland) ; Streaky Bay, *Tepper* (Herb. Tepper) ; Ardrossan, *Tepper* (Herb. Adel.) ; Port Lincoln, *J. B. Cleland* (Herb. Cleland) ; 40 miles north of Point Bell, *Tepper* (Herb. Adel.) ; Wilpena Pound, *B. B. Beck* (F. N. S. Herb. Adel.) ; Kangaroo Isd., *J. B. Cleland* (Herb. Cleland). Victoria. Mount Abrupt, *H. B. Williamson* ; Borung, 1904, *F. M. Reader* (Natl. Herb. Vict.) ; Glenelg R., *Robertson* (Herb. Kew.).
Flowering Season : May to October.

XXI.—THE "AERENCHYMA" OF SESBANIA AND NEPTUNIA.

C. R. Metcalfe.

An examination has been made in the Jodrell Laboratory of some material sent to Kew in July, 1930, by Miss E. R. Napier, of the Coryndon Memorial Museum, Nairobi. The substance was stated to have been found growing on the stem bases and roots of an aquatic species of Sesbania. In appearance it superficially resembled a resupinate Basidiomycete of a somewhat spongy consistency, but under the microscope it could be seen that it was not fungoid in origin. Before its structure was at all clear it was found necessary to heat sections in 10 per cent. caustic soda solution, when it became apparent that it was made up of very loosely arranged, slightly elongated, parenchymatous cells with abundant air spaces between them, the whole structure resembling a sponge. A tissue very similar in structure was first described on the roots of *Sesbania*

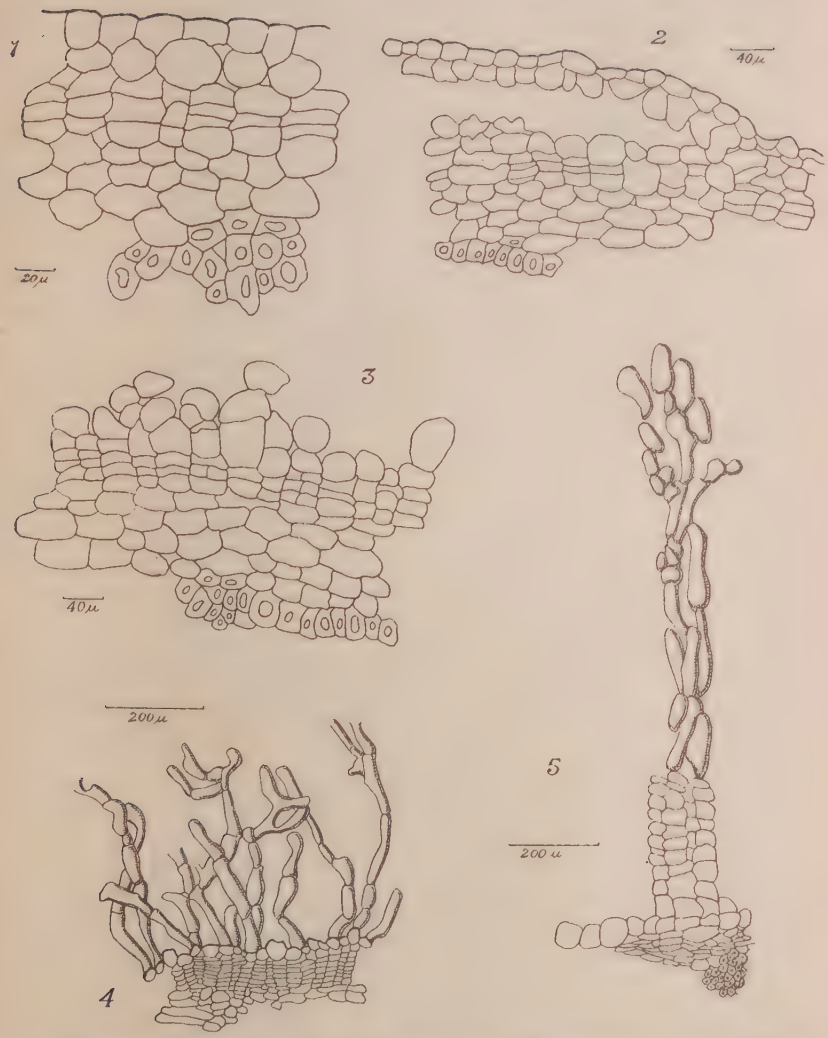
aculeata by Scott and Wager (1) in 1888, who regarded it as a floating tissue which served to facilitate respiration in the roots when these were growing in waterlogged conditions. These authors concluded that the tissue was homologous with cork, having traced its origin to the activity of a phellogen which arose immediately outside the endodermis in the roots. It differs from true cork, however, in having cellulose walls and in retaining the living cell contents.

In a more comprehensive investigation in 1889 Schenk (2) described similar tissues homologous with cork in several different families, including the species *Sesbania aculeata* and *S. marginata*. Since then the aerenchyma in this genus has received little attention. It is to Schenk that the term " aerenchyma " is due.

It has been very difficult to obtain any evidence concerning the mode of origin of the tissue in question, since the first material received was already detached from the plant on which it had been growing. In December, 1930, further supplies of *Sesbania aculeata*, and also an unidentified species of the same genus, were received from Miss Napier. This material was unsatisfactory because a great deal of the aerenchyma had already become detached, as it always does when it is old. However, it was found possible to corroborate the conclusions of Scott and Wager, and of Schenk, that the tissue arises as a secondary development from a phellogen situated in the cortex not far outside the endodermis. Between the spongy tissue and the phellogen there are formed radially arranged rows of cells. The general arrangement of the tissues is shown in Fig. 5, which must be regarded as partly diagrammatic since it has been reconstructed from two separate lots of material. In this figure a group of fibres is shown in the phloem.

Amongst other plants in which aerenchyma has been described is *Neptunia oleracea*. It was first noted on this plant by Humboldt and Bonpland (3) who, however, mistook the spongy tissue present on the submerged internodes of the stems for a foreign body. It was not until later observations were made by Rosanoff (4) in 1871, that the aerenchyma was recognised as a secondarily developed tissue arising from a phellogen at a short distance within the epidermis. These researches were noted by Arber (5) but otherwise the aerenchyma of this plant does not appear to have received any further attention. The present writer was enabled in December, 1930, to reinvestigate the formation of the aerenchyma, thanks to a supply of living *Neptunia oleracea* being obtained from the Oxford Botanic Garden.

The origin and development of the aerenchyma of *Neptunia oleracea* is illustrated in figs. 1–4. In the first of these it can be seen that certain cells a few layers within the epidermis are dividing and cutting off new cells towards the outside. Owing to the pressure set up by this growth the epidermis becomes ruptured (fig. 2) and the parenchymatous cells formed by the activity of the phellogen become exposed to the surface (fig. 3). The cells become separated



Neptunia oleracea, origin and development of aerenchyma. 1, Division of cells below the epidermis. 2, Rupture of the epidermis. 3, Exposure of parenchyma. 4, Separation and elongation of cells to form the aerenchyma. 5, Aerenchyma of *Sesbania* sp.

from one another and elongated in shape and the abundant spaces between them are filled with air. The mature aerenchyma is made up of these cells, which retain their cellulose walls and living contents (fig. 4).

From the manner in which the aerenchyma arises in these plants it is clear that the tissue is homologous with cork, since it arises from a phellogen in the same way as does true cork. Similar tissue arising in the same way is well known in *Jussiaea* spp. and other unrelated genera. It is of interest, however, that amongst the Leguminosae (to which *Sesbania* and *Neptunia* both belong) a similar tissue is sometimes formed by the normal cambium in plants growing in aquatic conditions. This is especially well seen in species of *Aeschynomene* where a pith-like tissue is produced in the place of the normal xylem of typical land plants.

Concerning the function of aerenchyma two main views have been put forward. One of these regards the aerenchyma as a development to facilitate the respiration of roots growing under waterlogged conditions, whilst the other looks upon the tissue as being of primary importance as "floating-tissue." In the author's opinion, however, it is probably safer to agree with Arber that "the formation of the secondary air-tissues is directly induced by environmental conditions and that their serving any purpose is to be regarded as quite fortuitous."

References.

1. Scott, D. H., and Wager, H. On the floating roots of *Sesbania aculeata* Pers. (with plate xvii). Ann. Bot. i. p. 307. 1888.
2. Schenk, H. Ueber das Aërenchym, ein dem Kork homologes Gewebe bei Sumpfpflanzen. Jahrbucher für Wiss. Bot. vol. xx. pp. 526-574, with plates xxiii-xxviii. 1889.
3. Humboldt and Bonpland. Plantae Acquinoctiales, p. 56, Paris, 1808.
4. Rosanoff, S. Ueber das Bau der Schwimmorgane von *Desmanthus natans* Willd. Bot. Zeit. Jahrg. 1871, pp. 829-838, 1 plate.
5. Arber, A. A. Water Plants. Cambridge, 1920.

XXII.—PALMSTRUCKIA OF THE FLORA CAPENSIS.

C. A. Smith.

Under International Rules the name *Palmstruckia*, assigned by Sonder (Harv. & Sond. Fl. Cap. i. 35 : 1859-60) to a monotypic South African genus of *Cruciferae*, is invalidated by the much older *Palmstruckia* Retz. (Obs. Bot. Pugill. 15 : 1810), given to a Scrophulariaceous genus [=*Sutera* Roth (1807)], both names commemorating J. W. Palmstruck, the then editor of *Svensk Botanik*. Thus Sonder (loc. cit.) states "*Palmstruckia*, M. C. Retz. Obs. Bot. 1810 =*Chaenostoma* Benth. [=*Sutera* Roth], a name now universally adopted, and which it seems undesirable to alter. The genus now proposed [i.e. *Palmstruckia* Sond.] will equally preserve Palmstruck's name to a Cape plant." The new genus and species, *Palmstruckia capensis* Sond., was established by him on a specimen collected by Thunberg, probably on the Roggeveld mountains between the 16th

and 18th November, 1774 ("Here the country was called the Lowermost [=Onderste] Roggeveld. . . ." Thunb. Trav. ii. 168), near the southern limits of the present Calvinia Division. This plant had apparently been confused by Thunberg (Fl. Cap. ed. Schult. 490 : 1823) with *Peltaria capensis* Linn. f. (Suppl. 296 : 1781), i.e. **Heliophila capensis** (*Linn. f.*) *C. A. Sm.*, comb. nov. [=*Heliophila Peltaria* DC. Syst. ii. 685 (1821) ; Sond. in Harv. & Sond. Fl. Cap. i. 43 (1859-60)], which according to Sond. (loc. cit. 43) is conspecific with the plant Thunberg (loc. cit. 491) had described as *Lunaria pinnata* Thunb., a strange confusion, since the younger Linnaeus and Thunberg must have described from the same types.

Palmstruckia capensis seems to have been missed by all collectors subsequent to Thunberg for more than a century until 1883, when, in September of that year, Harry Bolus rediscovered this interesting little plant in abundance "in lapidosis, Kasteelpoort, prope Klipfontein, in montibus Kaus," about 56 miles east of Port Nolloth in Little Namaqualand (*Bolus* 6502 !). At that time Bolus regarded the plant as a species of *Heliophila*, which it closely resembles, and it was not until October 1885 that Mr. N. E. Brown at Kew confirmed the specific identity of Bolus' specimens with the type of *Palmstruckia capensis* Sond. from Thunberg's Herbarium at Upsala. Besides rediscovering the species in a new locality, and so considerably extending the known range, Bolus was able to amplify Thunberg's and Sonder's descriptions in several important details, the emended description of the species with a short note appearing in the Journal of the Linnean Society, vol. xxiv, p. 171 (1887). Thus for the first time details of the flower structure (Thunberg's specimen being in the fruiting stage) and the foliage leaves were made available. Thunberg's description of the leaves as "filiform," noted by Sonder, applies, according to a ms. note by Mr. Brown, to the foliaceous bracts subtending the inflorescence branches, the specimen being without leaves.

It should, however, be pointed out at this stage that, while there appears to be no reason to doubt the conspecificity of the Bolus and Thunberg specimens, satisfactory confirmation can only be obtained by gathering the species in the "locus classicus" and comparing these specimens with the Bolus material.

Since it has been shown that Sonder's generic name cannot be retained under International Rules, the genus must receive a new name, for which the following, with details of synonymy, is proposed :

Thlaspeocarpa *C. A. Sm.*, nom. nov.

Palmstruckia Sond. in Harv. & Sond. Fl. Cap. i. 35 (1859-60) ; Benth. & Hook. f. Gen. Pl. i. 138 (1862) ; Harv. Gen. S. Afr. Pl. ed. 2. 10 (1868) ; Prantl in Engl. & Prantl, Nat. Pflanzenfam. iii. Abt. 2, 158 (1891) ; Marloth, Fl. S. Afr. i. 242 (1913) ; Thonn. Fl. Pl. Afr. 220 (1915) ; Phill. Gen. S. Afr. Pl. 272 (1926) ; non Retz. (1810).

Peltaria Thunb. Fl. Cap. ed. Schult. 490 (1823), non Linn. (1753).

T. capensis (*Sond.*) *C. A. Sm.*, comb. nov.

Peltaria capensis Thunb. Fl. Cap. ed. Schult. 490 (1823); non Linn. f. (1781).

Palmstruckia capensis Sond. in Harv. & Sond. Fl. Cap. i. 35 (1859-60); Bolus in Journ. Linn. Soc. xxiv. 171 (1887).

Calvinia Div.: In the Onderste Bokkeveld, in the vicinity of the Roggeveld Mountains, Nov. 1774, *Thunberg* (type in Herb. Thunb.).

Little Namaqualand: In stony mountainous places at Kasteelpoort, near Kliplontein, 1060 m., Sept. 1883, *Bolus* 6502! and in the same locality, 900 m., Aug. 1886, *Bolus in Herb. Norm. Austro-Afr.* 1102!

XXIII. A RAINING OR WEEPING TREE IN AUSTRALIA.

W. D. Francis.

In the "Brisbane Courier" of 8th November the existence of a "raining" tree in Queensland is reported. Specimens of the tree were sent to Mr. C. T. White, the State Government Botanist, who identified them as belonging to *Glochidion Ferdinandi* of the family Euphorbiaceae. It was suggested by Mr. White that the moisture deposited from the tree might be due to insects. In a subsequent issue of the "Brisbane Courier" appears a statement from Mr. Longman, Director of the Queensland Museum. Mr. Longman remarks that the surmise of the Government Botanist that the moisture is due to insect associations is entirely correct. Mr. H. Hacker, Entomologist of the Queensland Museum, investigated the matter and found that the liquid was derived from the larvae of homopterous insects belonging to the family Cercopidae. The insects of this family, according to Mr. Hacker, are sometimes called frog hoppers or spittle insects. It appears that the larvae suck the sap of the tree and excrete it in the form of froth. After losing some of its included gases the froth falls from the tree as a clear liquid.

Some years ago the present writer experienced the rain-like effect of the moisture released from *Glochidion Ferdinandi*. The tree was growing on the banks of the Dams Creek, One Tree Hill, near Brisbane. The falling droplets of moisture undoubtedly give one the impression of very fine rain. On returning to the Botanic Gardens, Brisbane, I informed Mr. Bick, the Director, and gave him the name of the tree. It transpired that one of his correspondents a few days previously had noticed moisture falling from a tree and had enquired as to its identity.

Glochidion Ferdinandi is a very common species in the coastal portion of Eastern Australia, where it ranges from Southern Illawarra (South of Sydney) in New South Wales to the Gulf of Carpentaria in Northern Australia. The tree is mostly found in Eucalyptus forests in damp situations and in luxuriant rain forests. It usually

attains about 50 feet in height and develops a short bole and extensive head of foliage even in rain forests. Occasionally, however, as in the rain forests of the Eungella Range to the West of Mackay it assumes the typical rain-forest habit which is characterized by a tall, slender bole and a small head of foliage.

XXIV.—MISCELLANEOUS NOTES.

Mr. R. A. Dyer, M.Sc., has succeeded Mr. C. A. Smith, B.Sc., as representative of the Division of Plant Industry, Department of Agriculture, Union of South Africa, at the Herbarium, Royal Botanic Gardens, Kew.

Ignatz Urban.—The death, on January 7, 1931, of Dr. Ignatz Urban, on his eighty-third birthday, removes an outstanding figure in Systematic Botany. Born at Warburg, Westphalia, in 1848, Urban studied Botany at the University of Berlin under Braun and Ascherson, and after a break in his studies due to the Franco-Prussian war, took his Ph.D. in 1873, with a thesis on germination, flower- and fruit-formation in the genus *Medicago*. After a few years as a schoolmaster at Lichterfelde b. Berlin he was appointed First Assistant in the old Botanic Garden at Gross-Lichterfelde, becoming successively Custos, Unterdirektor and Zweiter Direktor of the Botanic Garden and Museum, and took a considerable share in the planning of the new establishment at Dahlem.

Urban's interests were by no means confined to taxonomy, but he soon began to devote himself especially to the flora of tropical America, becoming editor of the monumental Martius' Flora Brasiliensis on Eichler's death in 1891. From 1893 onwards he paid special attention to the flora of the West Indies, on which he became an authority of world-wide reputation. During the thirty years, 1898-1928, he issued, under the title "Symbolae Antillanae," nine volumes containing researches, by himself and other workers, on West Indian plants, two of them being floras of Porto Rico and Santo Domingo respectively.

Unlike some taxonomists, Urban clearly appreciated the importance of the history of botany, his most important contribution in this field being an account of Plumier's Life and Writings (Fedde, Repert., Beih. v., 1920).

It is impossible, within the limits of this notice, to give even a brief outline of Urban's contributions to botany. Here it must suffice to mention his Monographs of Turneraceae (1883) and Loasaceae (1900), and to refer the reader to the Royal Society's Catalogue of Scientific Papers and other bibliographical works, for lists of his papers. His published work was polished and scholarly, and accompanied by full bibliographical references.

CARL HANSEN OSTENFELD.—With great regret we have to record the death of Prof. C. H. Ostenfeld, Professor at the University and Director of the Botanic Gardens of Copenhagen.

Prof. Ostenfeld had a wide range of interests and published many papers on taxonomy, geographical distribution, phytoplankton, marine spermatophytes, cytology and genetics. He is best known for his work on arctic and subarctic plant-life, and his studies on the botany of the Faeröer and Greenland are models of their kind. Professor Ostenfeld travelled extensively and frequently visited Kew. He was personally known to a wide circle of British botanists whom he met at the meetings of the British Association for the Advancement of Science, both in England and overseas. In 1927 he accepted the invitation of the Royal Horticultural Society to deliver the Masters Memorial Lectures in London and took for his subject "The present state of knowledge of hybrids between species of flowering plants." The Linnean Society of London recognised his merits by electing him a Foreign Member in 1929. At the Fifth International Botanical Congress, held at Cambridge in 1930, he represented the Government of Denmark, the Royal Danish Academy of Sciences and Letters, and the University of Copenhagen, and he contributed a paper on the genus *Larix* to the Section for Taxonomy and Nomenclature. On the taxonomy of northern genera and species he was an acknowledged authority. His loss will be felt by many to whom he had endeared himself by the sympathetic consideration which he showed to all who sought his valued assistance.

THORE C. E. FRIES.—We learn with deep regret of the death of Dr. Thore C. E. Fries at Umtali, Southern Rhodesia. Dr. Fries arrived in South Africa in August, accompanied by two students, to undertake a botanical expedition to Matabeleland. For this purpose he had fitted out at Port Elizabeth a large Ford lorry which was to be their home for several months. With this they hoped to make a large collection in Rhodesia during the summer months.

Dr. Thore Fries was Director of the Botanical Museum at Lund. In addition to his work on Swedish botany, he published, in conjunction with his brother, Prof. R. E. Fries, some valuable work on the flora of Rhodesia and East Africa. Prof. R. E. Fries was botanist with the Swedish Rhodesia-Congo Expedition in 1911-12, the results of which were published between 1916 and 1921. The two brothers collected together in East Africa from 1920 to 1922 and gathered a wealth of material in the Aberdares, Mt. Kenia and Mt. Elgon. In consequence numerous joint papers on the flora of these mountains have appeared, mainly in the Svensk Botanisk Tidsskrift and the Notizblatt of the Berlin Botanic Gardens. These have dealt with a number of genera, particularly *Alchemilla*, *Impatiens*, and the arborescent species of *Senecio* and of *Lobelia*.

Dr. Paul Ascherson.—Mr. C. J. Ascherson has presented a life-sized bust of his uncle, the late Dr. Paul Ascherson of Berlin. Dr. Ascherson entered the Royal Herbarium of Berlin in 1865 and was appointed Second Kustos in 1871. He was also Professor of Botany at the University of Berlin.

Dr. Ascherson was particularly interested in the flora of North Africa and made five expeditions to different parts of that region, publishing with Schweinfurth his "Illustration de la Flore d'Egypte" in 1887. In 1894 he commenced to collaborate with Graebner on the monumental work, "Synopsis der mitteleuropäischen Flora," 12 volumes of which have so far been published.

The Botanical Name of the Japanese "Old Woman" Lily.—The plant which bears this quaint vernacular (see Makino, *l.c. infra*) is generally known to botanists by the name *Lilium cordifolium* Thunberg (1794). This name was adopted by the late E. H. Wilson in his recent "Lilies of Eastern Asia," the latest monographic work on the genus (1925). He, however, in common with most authors who have dealt with this plant, quotes as a synonym *Hemerocallis cordata* Thunb. (1784). Investigation of these two names shows that Thunberg certainly had only one species in view, for he quotes his *H. cordata* as a synonym of *L. cordifolium*. He merely gave, *more temporis*, what perhaps he considered a "more suitable" specific epithet on transferring the plant from *Hemerocallis* to *Lilium*. Why subsequent crinologists have persistently adhered to the later trivial, although aware of the earlier one, is not clear.

This earlier trivial was not, however, overlooked by Makino (1913), when treating as a distinct genus the group of Lilies to which this species belongs, viz. *Lilium* Sect. *Cardiocrinum* Endl. He gives as authorities for the generic name "(Endl.) Makino," being apparently unaware that both Lindley and Klotzsch had already (in 1847 and 1854 respectively) independently raised Endlicher's group to generic rank. Makino uses the correct combination *Cardiocrinum cordatum* (Thunb.) Mak. for the species under discussion, citing *L. cordifolium* Thunb. in synonymy. It is therefore all the more strange that Wilson, whose monograph must long remain a standard work of reference on the species of the area dealt with, should have cited the combinations of Thunberg and Makino, under *Hemerocallis* and *Cardiocrinum* respectively, in synonymy, and yet have failed to make the correct combination under *Lilium*.

This is therefore now made, as below. Besides a few references apparently overlooked by Makino and Wilson, only relevant synonymy is subjoined.

Lilium cordatum (*Thunb.*) *Airy-Shaw*, comb. nov.

Hemerocallis cordata Thunberg, Fl. Jap. 143 (1784); Gaertner, De Fruct. iii. 484, t. clxxix, f. 5 (1791); Endlicher, Gen. Plant. i. 141 (1836).

Lilium cordifolium Thunberg in Trans. Linn. Soc. ii. 332 (1794); Klotzsch in Otto et Dietr., Allgem. Gartenzeit. xxii. 195-6 (1854), et ex Mohl et Schlechtend., Bot. Zeit. xiii. 445 (1855); Wilson, Lil. East. Asia 97 (1925); K. Krause in Engler, Pflanzenfam. ed. 2, xv*a*. 331 (1930).

Cardiocrinum cordatum (Thunb.) Makino in Bot. Mag. Tok. xxvii. 124 (1913).

For further synonymy and copious references, Makino's and Wilson's monographs should be consulted. H.K.A.-S.

Edible and Poisonous Fungi.*—Increasing demand has necessitated a third edition of the little guide to common species of Edible and Poisonous Fungi which is issued by the Ministry of Agriculture and Fisheries. Originally issued as Miscellaneous Publications No. 54, it now appears as Bulletin No. 23. In the matter of production this third edition is a great improvement on the earlier issues. Better paper and larger type render the text easier to read, while the larger size of page improves the appearance of the plates. The edition in cloth boards is nicely bound and makes a little volume of pleasing effect.

Jelutong.—It should have been stated that the note on Jelutong published in *K.B.* 1930, pp. 502–503, was prepared from information published, from time to time, in the Malayan Agricultural Journal, and from the Report on Forest Administration for the year 1929, pp. 17, 18, published as a Supplement on the 29th August, 1930, to the Federated Malay States Government Gazette.

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